PRACTICAL
ENGINEER

VOL. XV CHICAGO, DECEMBER, 1911 No. 12

A COMPLETE MECHANICAL EQUIPMENT

REFRIGERATION AND ELECTRIC POWER FOR A BUTTERINE FACTORY

By E. C. HITZE

ON MONDAY, OCT. 2, The John F. Jelke Co., makers of Jelke High Grade butterine, completed the occupation of and set in full operation its new and modern plant at 2636 West Polk St., Chicago.

The power plant has been built separate and away from the main building; both structures being of pressed brick and set back from the street to allow for a strip of lawn, effectively removing the unsightliness so much objected to where manufacturing plants are in or close to residential districts.

Entering the power house one is impressed by the flood of light, and the freshness of the air, several big engines are running yet there is no stuffiness, no oily odor, no sense of heat. Looking about for the cause, it is seen that the entire south wall is crowded with windows; the lower section of each window consisting of 2 sliding sashes, while the upper section is square, hinged at the top, and open. The entire tier of upper sections is mechanically operated from a shaft running

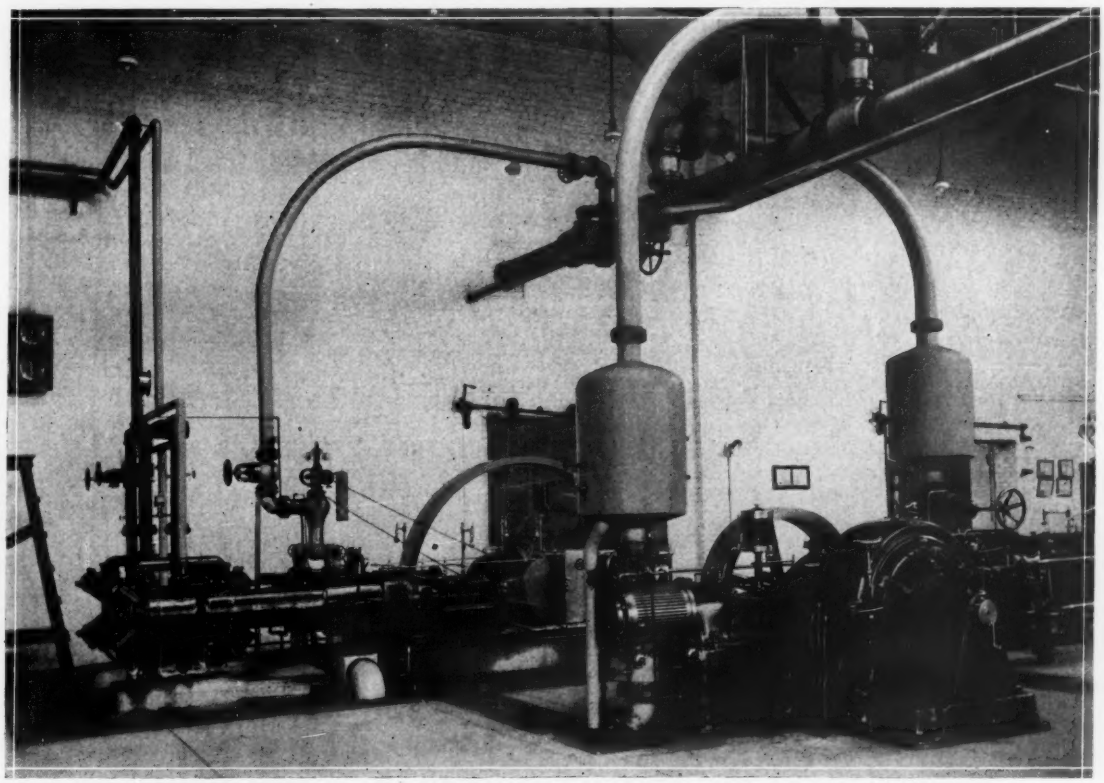


FIG. 9. AIR COMPRESSOR AND SMALL GENERATING UNIT

the full length of the room and regulated by a chain and sprocket at one end of the shaft, the chain dropping to the floor. At one end of the room, which is higher than the rest, a second row of windows is installed. In the roof are 2 large box sky lights, whose windows are also operated from the floor. These are open full.

surely has succeeded in supplying them. Besides there is room, plenty of it; nothing seems crowded; one can walk about and between the engines without fear of bumping elbows.

The completeness of the building is quite noticeable. At the west end is a large pipe and machine shop; next to this a lavatory; at the east end is a store

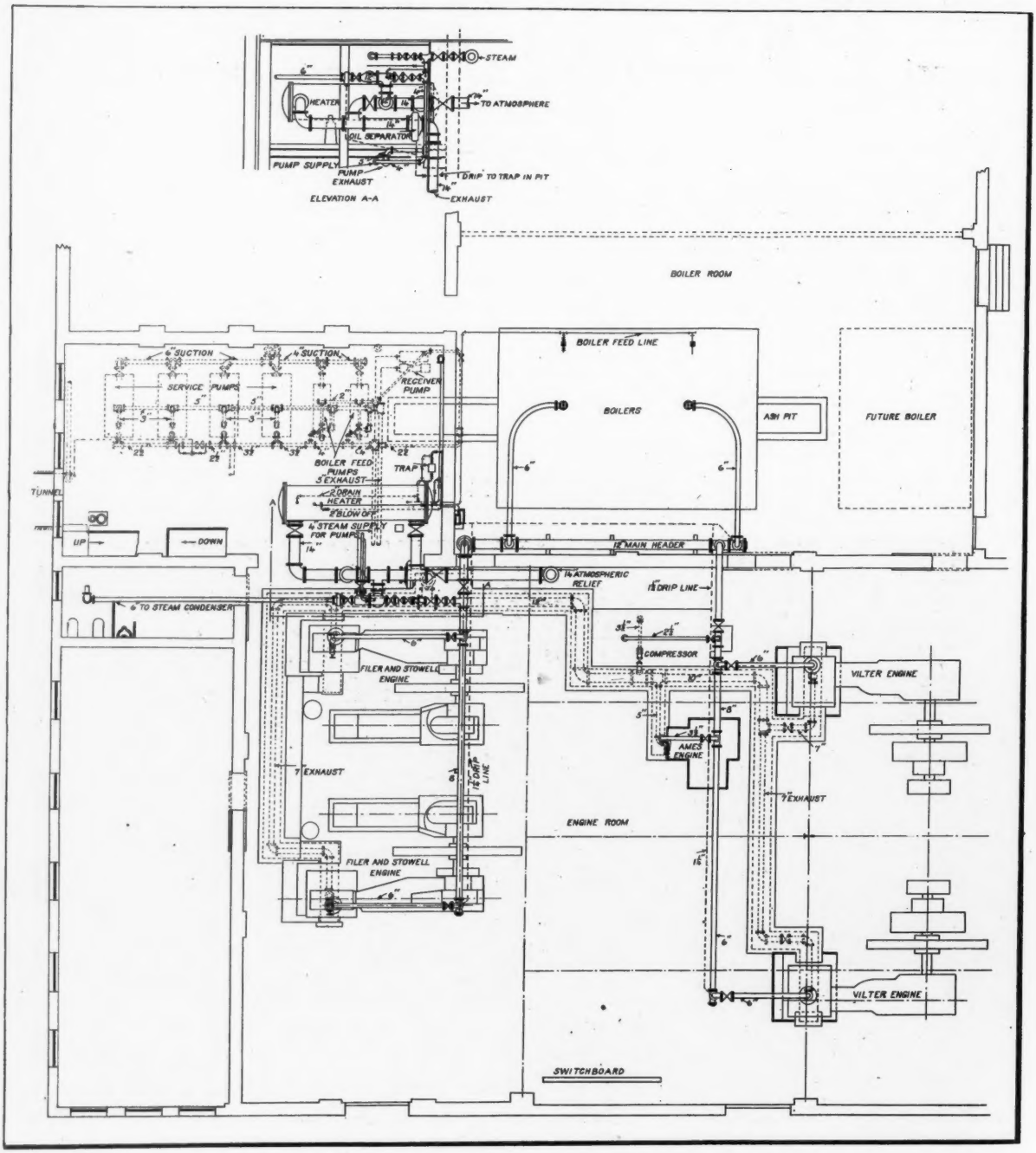


FIG. 1. PLAN OF POWER PLANT AND DETAIL OF MAIN EXHAUST PIPE CONNECTIONS

The ceilings and the walls are white, making the structural iron, painted dead black, stand out in bold but pleasant contrast.

That light and ventilation have been a prime consideration in the architect's mind is evident, and he

room and office, opening off the engine room. Beyond this is a section used as a garage and opening directly on the street.

An interesting feature is the pipe insulation. Practically every pipe or container carrying water or steam

is lagged with magnesia covering, the outside canvas being painted slate color. This tends to saving of fuel in the case of steam lines, and freedom from sweating and the resulting wetness from water lines, the whole making for neatness. As the plant is operated continuously, it has been necessary to install all important units in duplicate, in order that no time or material be lost through breakdowns.

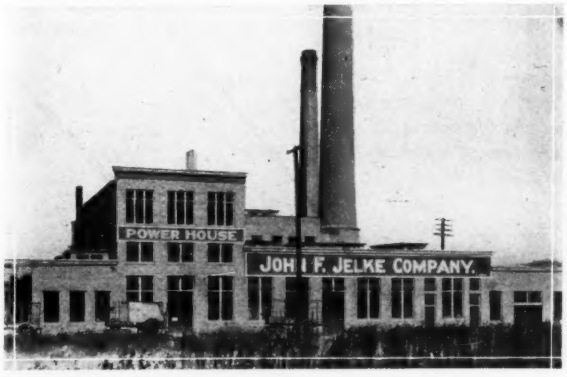


FIG. 2. VIEW OF PLANT FROM RAILROAD

Operating Force

IN the operating force are 3 shifts; 1 engineer, 1 fireman and 1 wiper constituting a crew, during the day one coal passer is also employed.

The power house is in charge of Jack Rentz, chief engineer, to whom we are indebted for much information.

At present 2 500-hp. Stirling boilers with Green chain grate stokers are installed, working at 150 lb. pressure. The columns supporting the roof are situated about 12 ft. from the boiler fronts, and back of these columns is a lower addition containing a track on which coal cars are run in and emptied, the size of

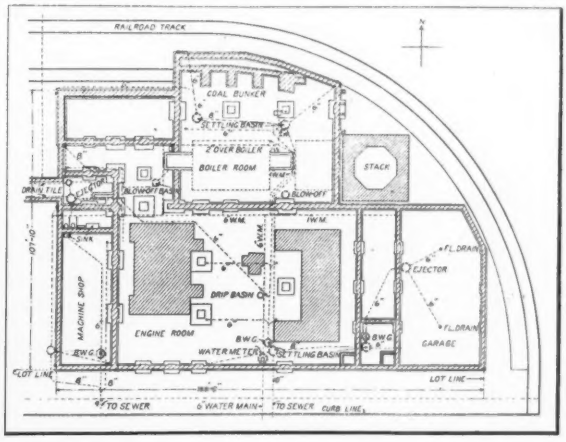


FIG. 3. PLAN OF FOUNDATIONS AND DRAIN SYSTEM

the pile of coal in front of the boilers being regulated by counterbalanced doors sliding between the columns. At present the hoppers are hand filled, but provision is made to have the coal supplied later from an overhead bin.

There is a 5-ft. space between the boilers and the back wall, affording ready access to the blowoff valves and line, which is placed above the floor level.

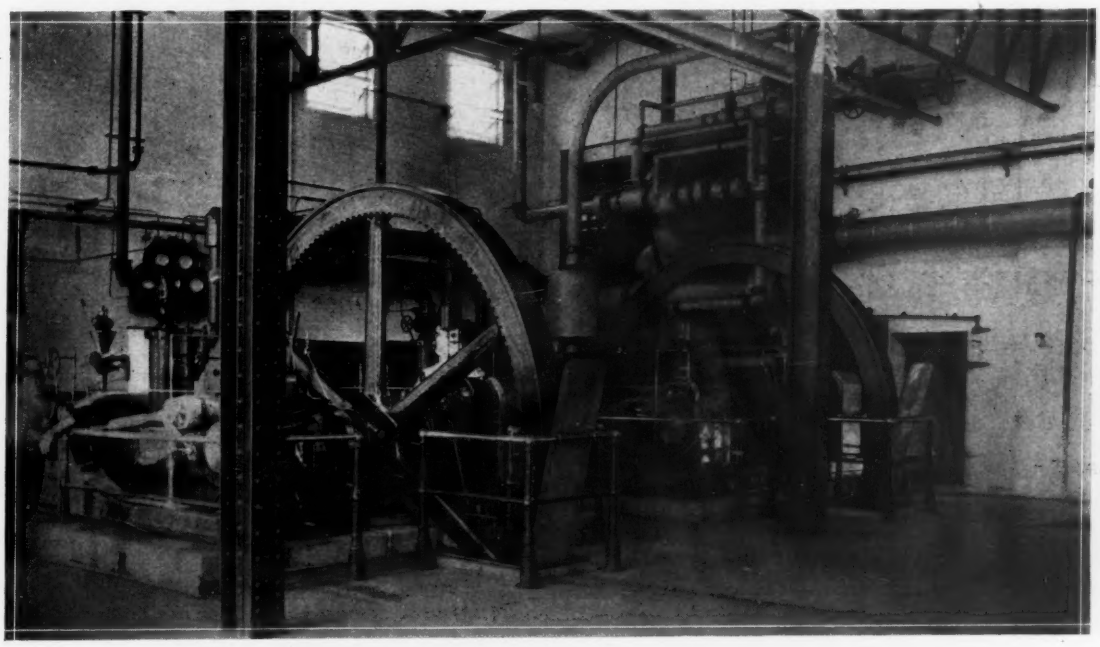


FIG. 6. ICE MACHINE, PIPING AND GALLERIES

Boiler Room

LOCATED on the north side of the building is the large, light boiler room, with a continuous series of windows occupying the north and south walls, and a large box sky light forming a greater portion of the roof.

A 12-in. main steam header running the width of both boilers is situated behind the boilers and rests on Crane roller brackets placed about 12 ft. from the floor line. Steam leaves the boilers through 6-in. long radius bends, horizontally placed, the lines extending to the back wall then dropping directly into either end of

the main header. The auxiliary steam header for the boiler feed pumps extends to the front of the boilers, running along the north wall and passes through the wall into the pump room.

The breeching extends across the top of both boilers, passing out through the east wall to the stack. In the breeching provision has been made for ready connection to a third boiler which may in the future, be installed, and for which floor space has been left.

Where the breeching passes from this building to the stack, it is carried through a brick tunnel supported on a reinforced concrete platform. The stack is 165 ft. high above the grate level, 8 ft. internal diameter. The base is octagonal, resting on a concrete foundation.

Engine Room

STEAM is supplied by 2 separate 8-in. steam mains, leaving the header near either end and running parallel across the room, supplying respectively the units in the east and west ends of the room.

Connections to each cylinder are made through long radius bends, dropping into steam separators before entering the cylinders.

The steam separating or drain system is noteworthy. The main header in the boiler room is the

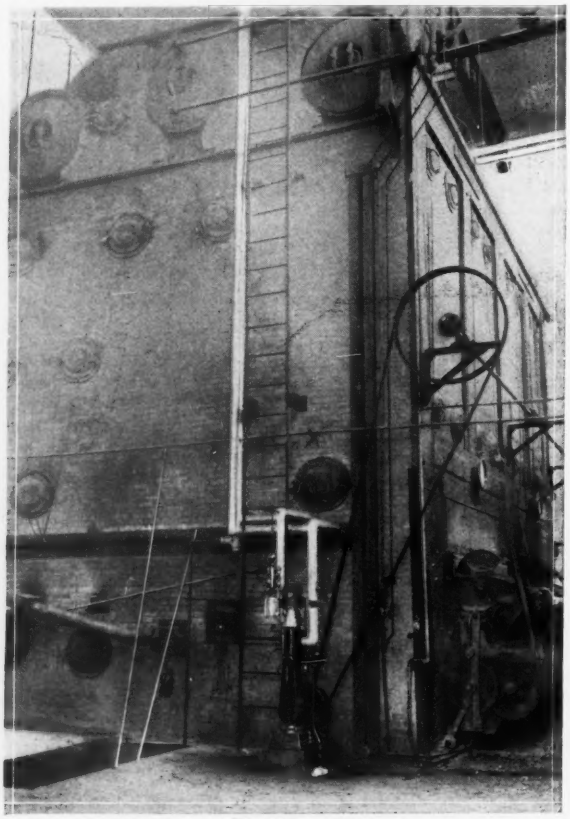


FIG. 4. THE STIRLING BOILERS WITH GREEN CHAIN GRATE STOKERS

lowest section of the high-pressure steam lines, and to it both mains have a tendency to drain. At the ends of each main, and under each tee from which the return bends leave, there is tapped a 1½-in. connection entering a 1½-in. drain line which follows directly under the main and has a slope back toward the main header. Here it meets a similar drain tapped into the main header under each end and under each tee and proceeds to a high-pressure Anderson steam trap.

Oiling System

FOR cylinder lubrication, an individual force feed lubricator is provided for each cylinder. For the other parts, a unit system has been adopted requiring little or no attention. On each engine is a Nugent unit oiling system, the reservoir of which is connected to a White Star Oil Filter located on the second gallery, above the engines. The used oil passes from each engine to a reservoir from which it is pumped to

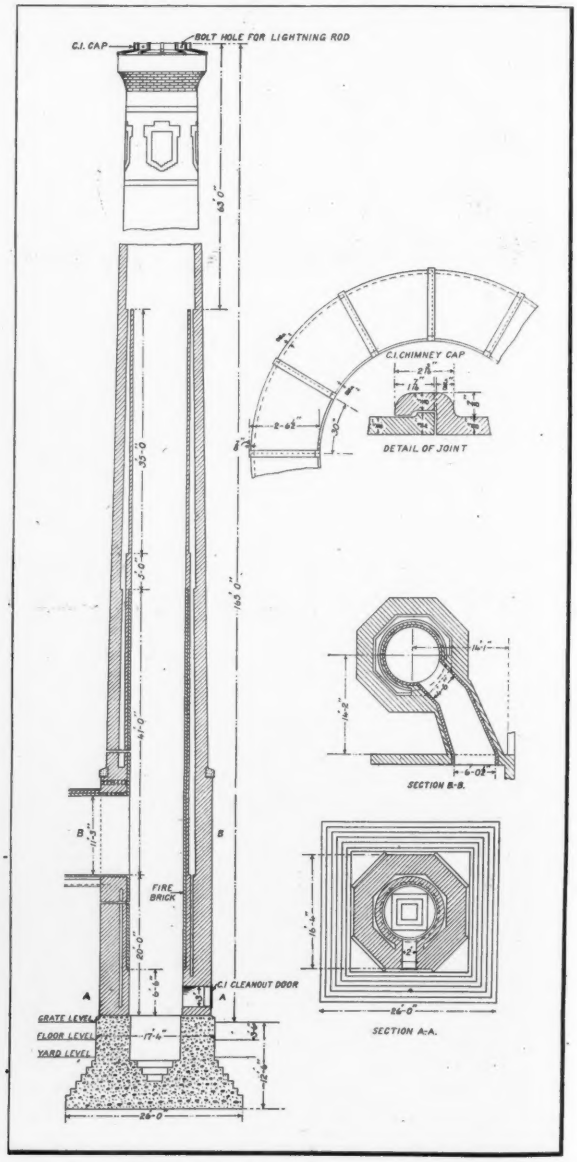


FIG. 4A. ELEVATION OF CHIMNEY AND SOME DETAILS

the filter. In this way a continuous automatic system is maintained.

Generators

THE power units, situated in the east end of the room, consist of 2 Sprague 8-pole direct-current generators each rated at 250 kw. at 220 volts direct connected to single cylinder, noncondensing Vilter-Corliss engines.

The latter are set in a slight depression in the floor, while the generators are placed over a pit, an arrangement conducive to cleanliness. One of the 2 steam mains supplies only these 2 engines.

Hills-McCanna force feed lubricators attached to the side of the cylinder supply the cylinder lubrication, all other parts being supplied by the central system.

Lighting System

THE 3-wire, 220-volt system is employed. During running hours, the lighting current is furnished by the large power units, the equality of distribution being maintained by a Sprague balancing set, of which 2 are installed alongside one of the large generators. To provide light for times when the main generators are idle, or to relieve them when heavily loaded, there is provided a Sprague direct-current generator, Type S B, rated at 50 kw. on 220 volts direct connected to a high-speed Ames engine.

Ammonia Compressors

AT the west end of the room are 2 120-ton 18 by 20-in. Linde ice machines, made by the Fred W. Wolfe Co., cross connected to 20 by 42-in. Filer & Stowell single cylinder noncondensing Corliss engines. These 2 machines, with the compressor and Ames engines, are supplied by the second steam main. Each cylinder, as well as all others in the plant, is provided with a large steam separator and relief valves.

On these machines also, the cylinder lubrication is furnished by Hills-McCanna lubricators, all other lubrication by the Nugent system. The ice making equipment is placed in the main building, the ammonia lines being carried to the other building through an underground tunnel.

Switchboard

THE electrical apparatus is controlled by an 8 panel blue marble switchboard, Fig. 8. The first 2 panels belong to the power units, the third one to the

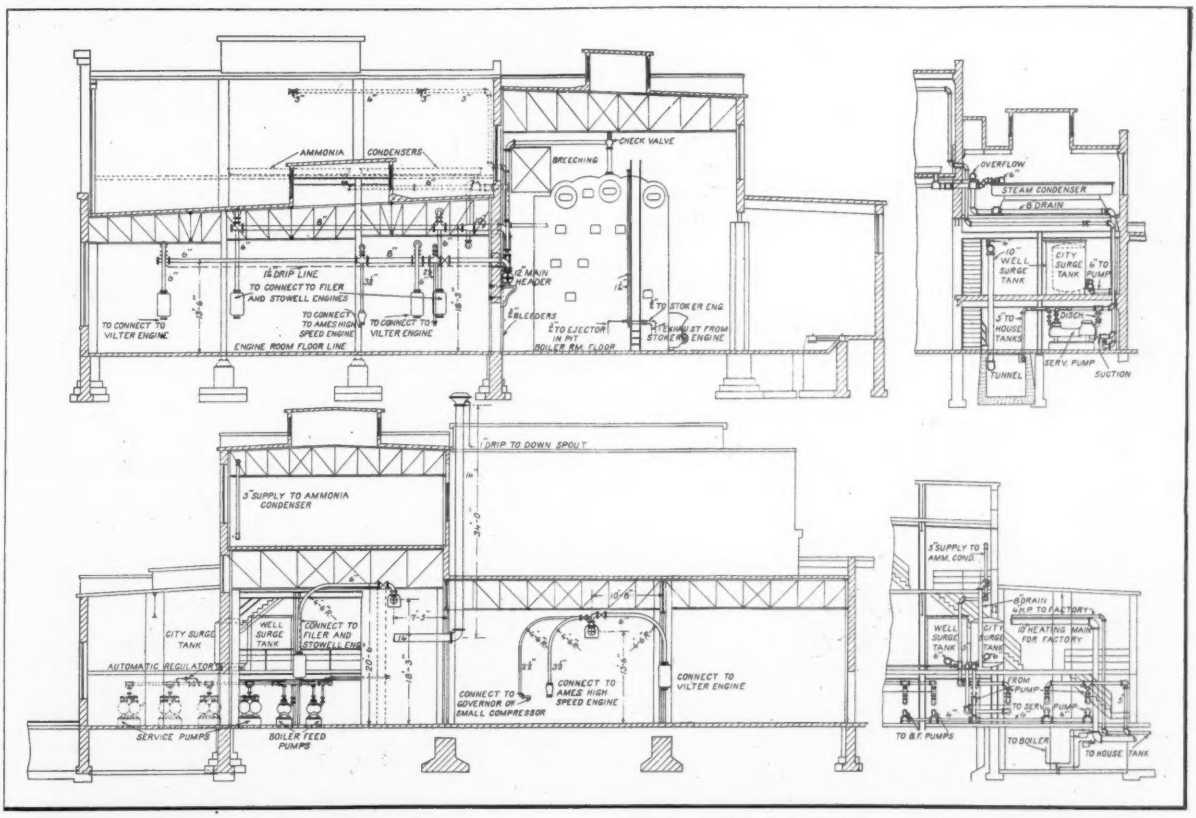


FIG. 5. SECTIONAL ELEVATION OF THE PLANT, LOOKING WEST
SECTIONAL ELEVATION LOOKING NORTH
SECTION OF AUXILIARY GALLERIES, LOOKING WEST
AUXILIARY GALLERIES LOOKING SOUTH WITH NORTH WALL REMOVED

Air Compressor and Water Supply

ALONGSIDE the Ames engine is a small 2-stage air compressor, as shown in Fig. 9. All the water used in the plant, except for boiler feeding, is obtained from a well 1640 ft. deep, within the power house, the water being raised by air lift, supplied by the compressor.

The consumption of city water is measured by a Worthington Model D disk meter, placed to the left of the switchboard. Water enters and leaves the meter through pipes extending directly through the floor, only sufficient piping being exposed to allow for a valve on either side of the meter.

lighting dynamo, 4 and 5 to the balancers, 6, 7 and 8 are distributing panels.

On the first 2 panels the main switch is at the bottom. Directly above are double pole I. T. E. circuit breakers, to the right of which are the rheostat handles. At the top are the measuring instruments, made by the Sangamo Co.

Each generator panel is equipped with a small red signal light to indicate when it is in operation, the switchboard lights being controlled by pearl push buttons placed at the edges of the panels opposite the circuit breaker. Leads to the machines and to the main building are placed in conduits under the floor,

the absence of overhead wiring adding greatly to the appearance of the power plant.

Exhaust System

IN Fig. 6 is shown the 15-in. exhaust steam header coming from beneath the floor. The exhaust line from each engine is conducted through covered trenches, Fig. 1, a trench leading from each engine to the header. The stem and handle of exhaust valves only are above the floor, as shown in the views. Exhaust steam is used for 3 purposes: water for ice making, heating and feed water heating, being proportioned by regulating the valves.

An oil separator removes all oils before the exhaust passes to its various destinations. In case all the exhaust is not utilized, an atmospheric valve allows the escape of the surplus through a branch extending to the roof, shown in Fig. 1.

Accessories and Other Apparatus

THE small sections of the building shown in Fig. 5, built in 4 galleries, accommodates the smaller apparatus. The first gallery, leading directly off the main floor, contains 6 Deane pumps, 4 Anderson steam traps, and waste oil filters. The pumps are all in duplicate, set high off the floor and each lubricated by a Hills-McCanna force feed lubricator.

The first 2 pumps, the furthest shown in Fig. 10, are house pumps 12 by 9½ by 12 in., supplying the water for the buildings. The pump operation is controlled automatically by the pressure in a storage tank placed in the highest part of the main building. The governing valve is placed in a by-pass around a valve in the steam line, so that in case the automatic valve becomes disabled, the bypass can be closed and steam admitted through the hand controlled valve.

The middle pumps, 12 by 9½ by 12-in., supply the water to ammonia condensors. The last 2, 10 by 6 by 12-in., are boiler feed pumps. To supply these pumps with steam a branch is taken from the auxiliary header so that they may be controlled by a valve in the boiler room, obviating any necessity of the fireman leaving the boiler room to regulate his water supply. In this gallery is the entrance leading down into the tunnel through which all lines are carried to the main building.

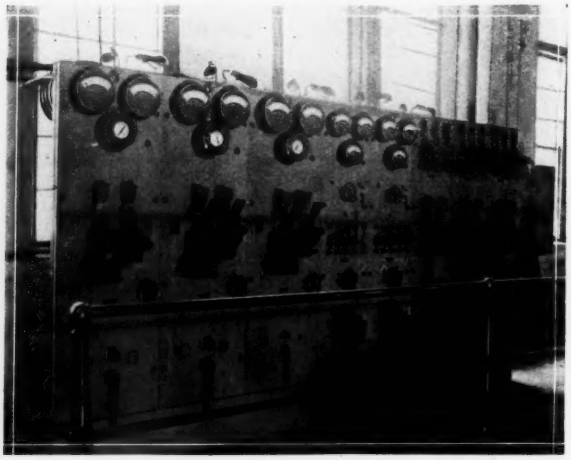


FIG. 8. THE SWITCHBOARD

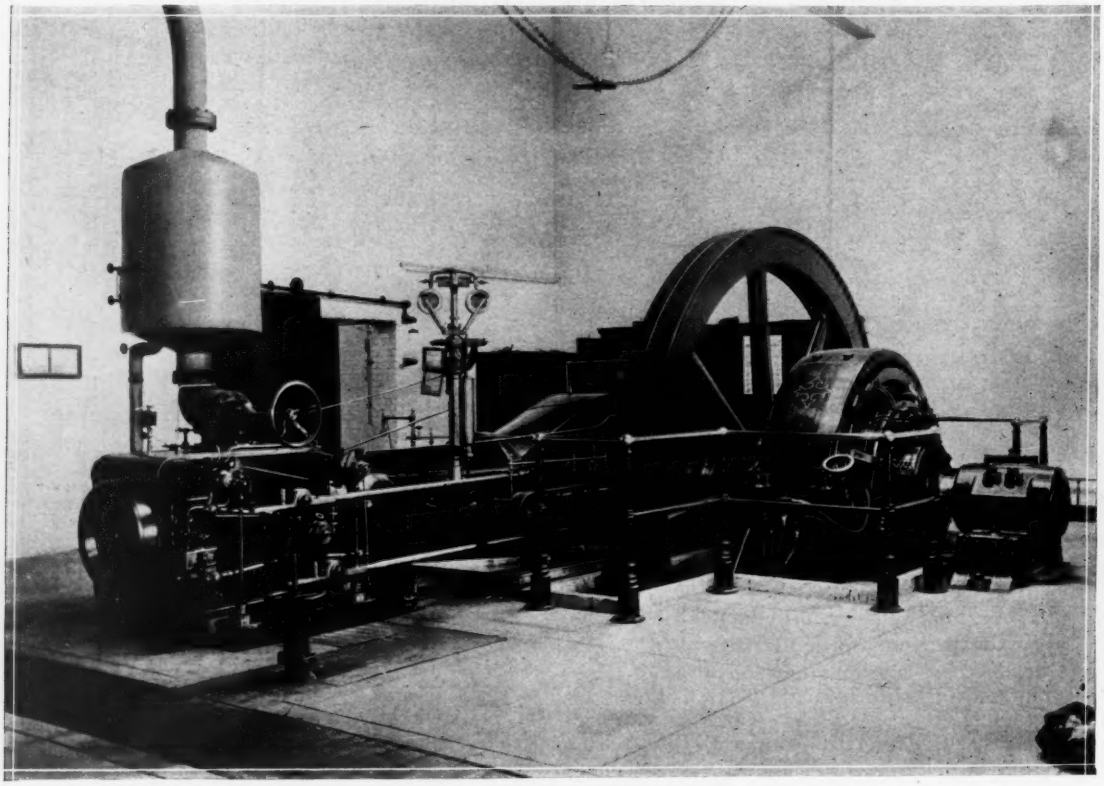


FIG. 7. ONE OF THE LARGE GENERATING UNITS

To the left of the pumps are the waste oil filters, consisting of 4 F. C. Wilson & Co.'s and 3 Turner

cabinet filters. All the different oils collected from the machinery are filtered in these respective filters.

The steam traps drain the main steam lines to the engines, the steam line to the pumps, the receivers and the exhaust main.

On the second gallery we find first, 2 International water filters with 150,000 gal. capacity per day of 10 hr. All the city water used is here filtered and emptied into a large surge tank adjoining, from which the water is then drawn. Both the filters and all connected piping are completely lagged with magnesia covering.

An air reservoir equipped with a pop safety valve, and the surge tank to receive the well supply are located next to the filters.

Directly behind the exhaust piping seen in Figs. 1 and 6 is a 1200-hp. Kroeschell Bros. heater for heating the boiler feed water; this heater is entirely encased in a magnesia lagging.

To proportion the amount of steam admitted, a valve is placed in the exhaust main directly ahead of the heater, and directly ahead of this valve the 6-in. branch leads off to the pan condenser. As the heater is situated well above the pumps, hot water may readily be handled.

The third gallery contains the open pan condenser, 12 by 18 by 1½ ft., in which the steam used for ice is condensed. From the condenser the water runs to a reboiler, heated by a live steam coil, boiled again, and then cooled and filtered before being delivered by a small pump especially provided, to a storage tank in the main building. This process insures pure, clear ice.

The fourth gallery is situated over the main part of the power house, reached by stairs from the third gallery. Three sides of this room are exposed, allowing an unbroken series of windows all mechanically operated. With a large sky light and the white walls, light and air are provided in abundance. In the center of the floor are the ammonia condensers, Fig. 11, surrounded by a low concrete wall forming a pit from one corner of which the condensing water is drained. By this arangement the floor of the room is absolutely dry. Space is provided for another condenser, should it be needed. Being at the highest part of the building and open to the winds, the excellent ventilation of this room, due to its location and design, helps considerably in the process of cooling the ammonia.

THE ANNUAL CONVENTION of the Practical Refrigerating Engineers Association will be held at Houston, Tex., Dec. 7 to 9. The Macatee Hotel has been selected as headquarters and arrangements have been made so that those attending the convention can secure tourists' rates of a fare and a third. Among papers which will be read are: Heat and Cold, by V. H. Becker; Distilling System, by F. H. Ladd; Care and Management of Steam Boilers, by R. T. Burwell; Brewery Refrigeration, by Carl Nesler; The Engine Room, by H. C. Cook; Lubrication, by Robert Jeffrey, and Clear Ice from Fresh Water, by F. E. Voorhies. Other papers are being arranged for and will be presented if secured.

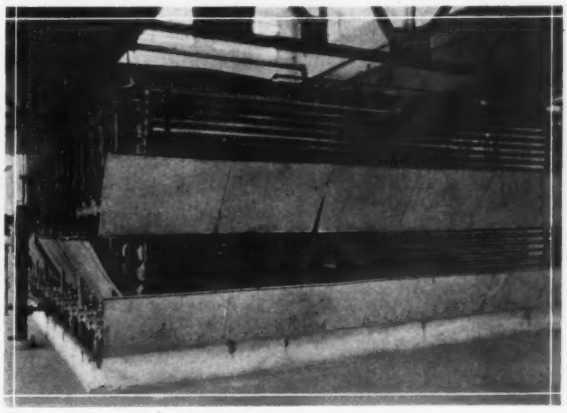


FIG. 11. AMMONIA COIL CONDENSERS IN THE 4TH GALLERY

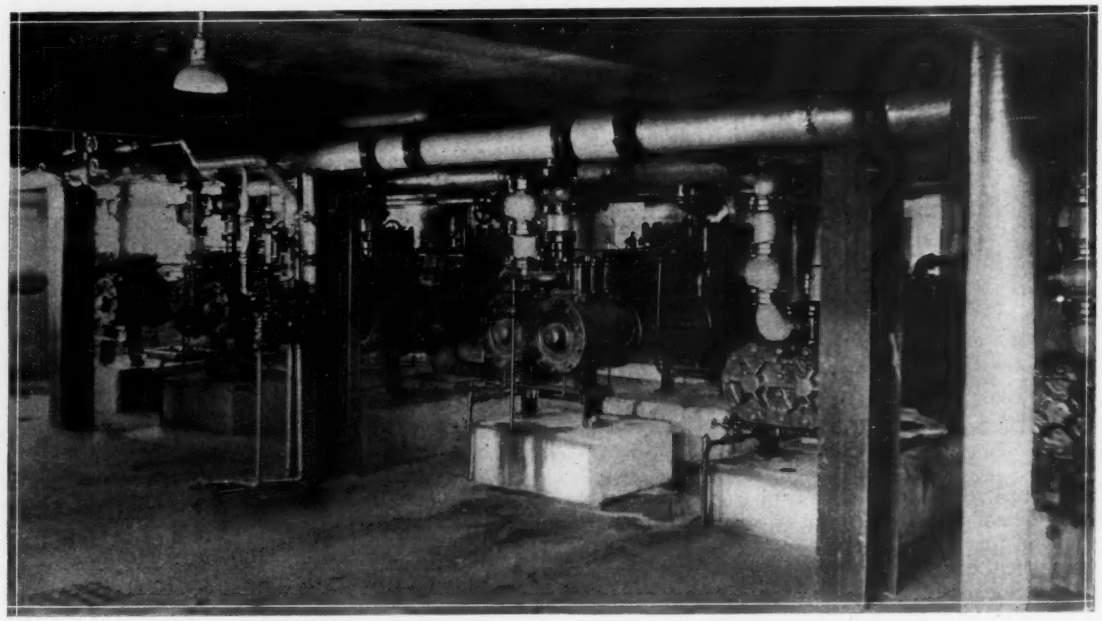


FIG. 10. PUMPS AND FILTERS IN THE FIRST GALLERY

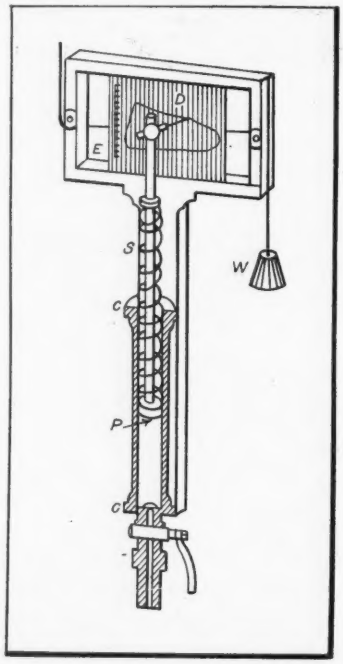
THE INDICATOR AND ITS USES

THE ESSAY FOR WHICH WAS AWARDED THE GOLD PLATED LIPPINCOTT INDICATOR BY THE NATIONAL EDUCATIONAL COMMITTEE, CINCINNATI, SEPT. 1911

By Edward J. Rose

IN THIS ESSAY on the steam engine indicator, it would be ungrateful if we did not in the commencement mention the name of that great genius, the inventor of it and many other valuable instruments that we use in various ways in handling steam,—James Watt, whose master mind gave to us the principles and improved action of the steam engine. After inventing the indicator it was possible for him to work out the problems to obtain the most power with his steam engine from the least amount of coal.

He also discovered 3 important laws in steam engineering: 1st, that a cubic inch of water converted into steam will lift one ton a foot high; 2nd, it takes little more fuel to evaporate a cubic inch of water at a pressure of 200 lb. to the square inch than it does



THE INDICATOR AS USED BY WATT

to evaporate it open to the atmosphere; 3rd, the gain in power depends upon the number of times that steam is permitted to expand.

It was in the year 1764 that Watt effected his engine improvements and for it, and his numerous other inventions he will always be awarded first rank in the engineering profession.

Many years after the indicator was improved by McNaught of Glasgow; modified forms of the McNaught instrument were made both in England and the United States, and with the continual increase in engine speeds and pressure, there has come demand for better and better indicators, to meet which manufacturers have brought forth indicators that are as near perfection as it seems possible to make them.

Uses

AS to the utility of the indicator in the steam plant, it is one of the most essential instruments we have. With it we cause a steam engine to write on a piece of paper an accurate record of the performance of the steam within the cylinder, and by engineers it is looked upon as the most reliable indication they can have of the work done by an engine.

It shows all the functions of the valve motion, the horsepower that the engine is developing in the cylinder at any point of the stroke, the efficiency of the steam ports and passages, the effect of the condenser.

On the steam chest it will show the loss of pressure due to small pipes or long pipes; on the exhaust pipe it will show the cause of excessive back pressure, whether due to small exhaust pipe or port openings; on the boiler it will register the pulsations caused by cutoff valves; on the engine it will furnish us with a correct diagram from any type of cylinder, single, compound, or triple-expansion steam engines; gas, gasoline or oil engines; ammonia and air compressors, water and steam cylinders of feed pumps, receivers and vacuum pumps; and give us correct readings of all pressures and grades of expansion met with in engineering practice.

The indicator is the engineer's stethoscope for the observation of what transpires within the cylinder.

In this time of keen competition, with the rush to increase production at reduced cost, engines are not accepted by purchasers without having an indicator diagram taken to show the action of steam and the horsepower at the proper speed. The indicator is further utilized to ascertain the amount of steam per hour that the engine is using, which amount is usually then reduced to the amount of water required by the engine per horsepower per hour, so that it can be compared with other engines.

As engines are of different types and are run under differing conditions, indicator cards must be taken from which the horsepower is obtained, and as the amount of water that the engine uses in an hour can be measured, by dividing that quantity by the horsepower, the real amount of water that the engine uses per horsepower per hour can be calculated. The indicator diagram is used therefore as an index of the economy. It also shows the nature of the faults by which the power is decreased.

Diagrams may show that the steam or exhaust ports are too small or the valve has not sufficient lead or is improperly set. The diagram shows the excess of pressure on the steam side of the piston tending to produce motion, over that on the exhaust side which resists it. There is no other invention pertaining to the science of steam engineering that can read the inner workings of the steam engine; the indicator demonstrates the economy of using steam at high pressure and the benefit of expansion. It also shows the initial, mean effective, terminal and back and cushion pressures, whether by compression or lead.

We rent power by the use of the indicator; the process of measuring it consists of indicating the engine first with the machinery in operation and then with the driving belt or shaft thrown off; the differ-

ence between the amounts of power developed in the 2 cases is the desired result.

As to the operating engineer, he finds his indicator indispensable, and it frequently has been the means of increasing his remuneration. Its use shows him to be scientifically trained in his profession, and engineers are often asked when applying for a position, "what is your experience with the steam engine indicator?"

The man who pays the coal bills wants to know from his engineer the amount of coal consumed per hour for each horsepower developed. It is the study and workings of this instrument that furnish us this important knowledge. With the indicator we find whether we are using a lot of steam and getting little horsepower or a lot of horsepower with but little steam, the same as we can find out from a fluegas analysis instrument whether we are burning a lot of coal and getting a little steam, or a lot of steam from but a little coal. These 2 subjects are the most important and interesting in our plant.

As to the benefit to be derived from a system of diagram records, they are not only an inspiration and guide, but the means of saving thousands of dollars in many manufacturing plants. The indicator applied at regular intervals detects any unusual friction load such as line shafting getting out of alignment or other cause that develops, that would be noticed only in the increase of running expenses. In other words, the indicator discovers the leaks in the power. Two cases in particular I wish to mention out of many which prove the value of keeping indicator records: At a large manufacturing plant, a friction load of 61 hp. gradually developed; this loss was found due to the line shafting being out of alignment.

Another interesting case was when the indicator diagrams won a law suit. The engineer of this plant had records of all the engines of which he had charge, and horsepower constants were kept on file so that as a card was taken he figured only his mean effective pressure multiplied by the constant; that gave him the horsepower as well as keeping him enlightened as to the conditions of the engines.

One of those engines was replaced by a larger one and the small one was sold with a good record back of it, and in good condition at the time of sale.

After being transferred to the new location it gave the new owner so much trouble that he refused to pay for it and his claim was that the engine had been misrepresented.

The engineer who had the diagrams from this engine was a witness for his employers and when asked by the court to state his case, produced indicator diagrams and explained them, and the judge very wisely advised having this engineer take diagrams from this engine at its new location. The engine was found to be working under very different conditions and had to run the opposite direction, but at the same speed as formerly. The first indicator diagram taken located the trouble plainly, as it indicated that the engine valves were so much out of adjustment that the planimeter measurement read 38 lb. mean effective pressure on the head end to 10 lb. on the crank end.

The valves were then adjusted with the result that the second diagram was so near to 24 lb. at each end that it was considered correct. Readjustment of valves of course made the engine run smoothly, as it gave an equal load on each end.

These diagrams were brought before the court with the result that a settlement was made that was satisfactory to all concerned.

I have written this story to show that in this case the operating engineer was so familiar with his indicator that it was unnecessary to call in an expert. The indicator is within the understanding of engineers not technically educated. With the advantages offered by the manufacturers of indicators, no engineer should be without one of his own; the day has gone by to send for an expert to indicate our engines; conditions have changed, so that we now adjust an engine when it needs it, and we get the advantage of running with the best economy.

The student finds a certain fascination in the study of indicator practice and the man who takes pride in the diagram records of his steam plant is sure to be a man who knows the fundamental principles of engineering. He will use the indicator in every conceivable way that will improve the running conditions of his plant to the mutual benefit of his employer and himself, and in so doing he will find that the indicator is essential and indispensable.

TYPES OF INDICATORS

DETAILS OF ENGINE INDICATORS; COMMERCIAL INSTRUMENTS

IN the mind of the engineer, the word "instrument" brings thoughts of science and precision, and in no case are those terms more applicable than to the modern engine indicator. It is the pet of the engineer who wants to know the why, the how, and the how much of his engine; it is the one instrument which proves the value of an engine; it has indicated

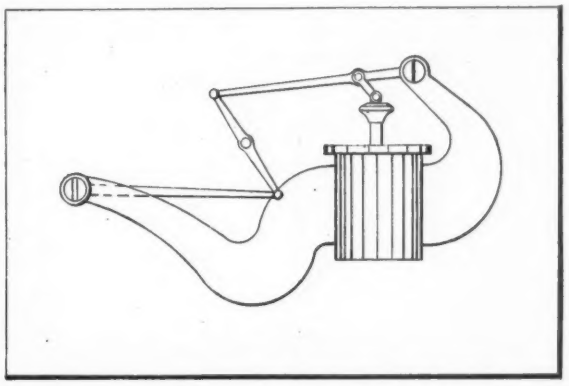


FIG. I. RICHARD'S PARALLEL MOTION

to scientists what paths to take in developing engines; yet its principles are so simple they seem like axions, crude perhaps, but sound. Upon these principles, scientists have been at work until to-day the result is a number of types of indicators which signify accuracy, combined with simplicity and durability.

Characteristic features of the different makes of indicators lie principally in the parallel motion and pressure springs, although the style of the spring used in the drum, method of steam jacketing, manner of attaching instruments to the cock, detent appliances, and so forth, are details which should not be overlooked.

Parallel Motions

ONE of the most difficult problems which have been met in the delvelopment of indicators was to secure a pencil motion which would draw a line parallel throughout to the path of the piston and proportional

in length to the piston travel without making it cumbersome and subject to errors due to inertia and friction.

Among the first motions which comes within modern practice was that invented by C. B. Richards, in 1862, and is shown in Fig. 1. It is still used on some instruments for moderate speed engines. Considerable improvement was made on the motion by J. W.

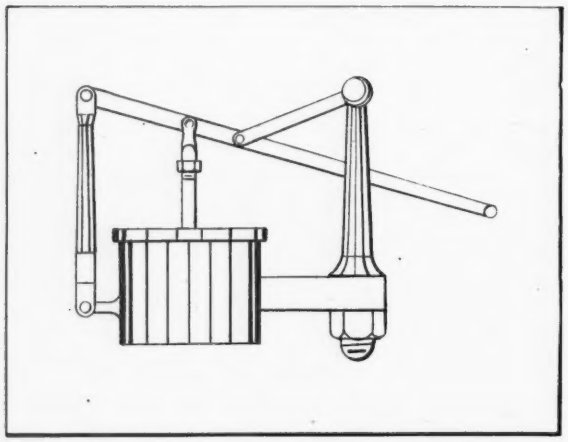


FIG. 2. PARALLEL MOTION DEVISED BY THOMPSON

Thompson, whose device is shown in Fig. 2. This adapted the instrument to high-speed engines. The principal advantages of this motion over those previously used are reduced weight, and consequent reduction of inertia and friction.

Another parallel motion which is extremely light in construction was invented by G. W. Brown. By this arrangement of links and pencil bar the travel of the pencil is made 6 times that of the piston, thus making it possible to obtain a well-proportioned card

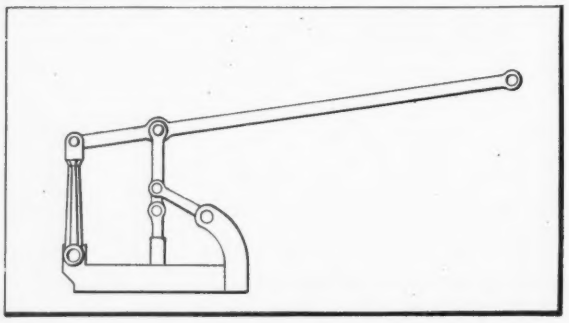


FIG. 3. BROWN'S PARALLEL MOTION

without compressing the spring greatly. This motion, as used by the Crosby Steam Gage & Valve Co., is shown in Fig. 3.

In the Tabor instrument, the pencil is compelled to travel in a straight line by a stationary plate in which a curved slot is cut to guide a pen attached to the pencil bar. This motion, shown in Fig. 4, has but 3 moving parts, and thus can be made extremely light to overcome inertia effects.

Rectilinear movement of the pencil is obtained in some indicators by guiding it in a slot, the pencil arm being carried upon links, one from the piston and the other from a rigid support on the cylinder cap. This style is shown in Fig. 5.

Pressure Spring

JUST what form of spring to employ in indicators has been the cause of development of several excellent types. The original indicator pressure spring was, most naturally, the ordinary coil spring that was made to be used as either a compression or extension spring, fastened rigidly at each end. This has developed into a single spring attached at each end to a nut in such a manner as not to change the curvature of the spring at the ends. Some springs have the

FIG. 4. TABOR PENCIL MOTION

pitch of the coils near one end changed so as to reduce the weight of the moving head and still maintain accuracy.

Another form is the double coil spring, fastened at each end into a nut in such a way as not to change the curvature of the spring. This has been changed in some types to a double spring made from a single wire with a ball and socket joint at the moving end of the spring, the ends of the wire being fastened into a nut as in the former case.

Increased use of high pressures superheated steam and internal combustion engines caused the develop-

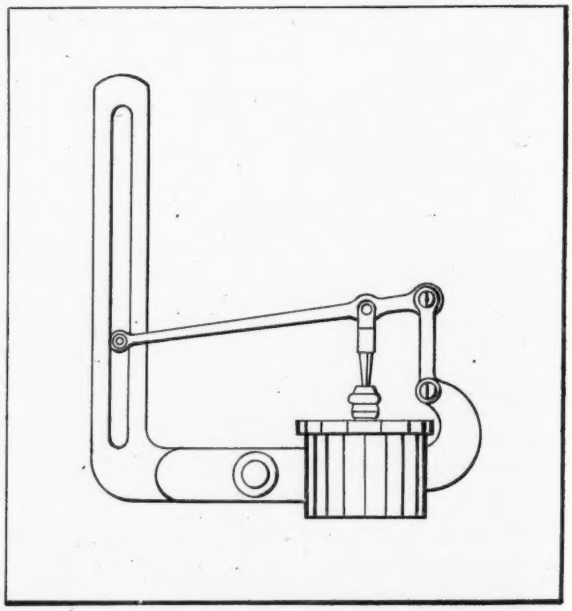


FIG. 5. THE LYNE PARALLEL MOTION

ment of indicators with the spring exposed to atmosphere, as the inclosed spring is subject to change in temper, due to extreme heat. Nearly all modern indicators are now made in both the enclosed and exposed types, the design being changed slightly to accommodate the location of the spring. There is little

difference in the class of spring employed, since it performs the same duty, whether enclosed or exposed.

Under the exposed type of indicator pressure springs may be classed the tongs-shaped spring, which is used to some extent, particularly on English indicators. This is a simple spring placed above the parallel motion of the instrument, and operated directly by the piston rod. It is of such shape and temper that it will record either pressure or vacuum as encountered in condensing engines.

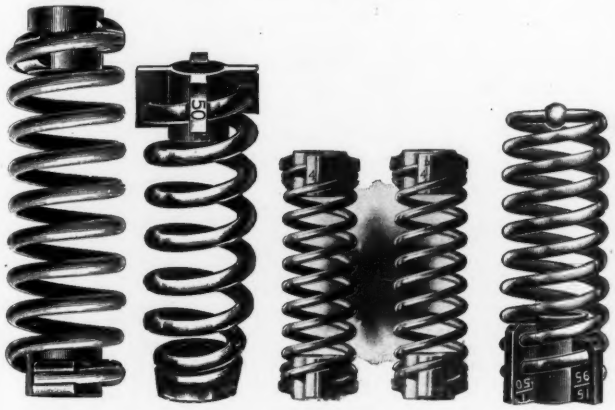


FIG. 6. TYPES OF SPRINGS; AMERICAN-THOMPSON, LIPPINCOTT, TABOR FOR INSIDE AND OUTSIDE CONNECTION, SCHAEFFER & BUDENBERG

While the original mechanism for operating the drum was a string and weight, this proved unsatisfactory, particularly for higher-speed engines, and drums in modern instruments are invariably operated by springs. These are placed inside the drum, and may be either a coil or spiral shape of spring, the method of adjusting the tension varying with the make of instrument.

In the earlier types of instruments, condensation of steam in the cylinder was the source of error, and in later models this has been eliminated by a steam jacket. Another detail of construction which has improved the accuracy of indicators is the provision of a steam port in the upper part of the cylinder to allow the steam which has escaped past the piston to go directly to the atmosphere without causing any back pressure.

Piston heads employed in the construction of indicators are made to fit closely without rings, and instead of packing have shallow grooves turned upon them. When in operation these grooves fill with condensation which prevents steam from leaking past them.

With the ordinary instrument, the card made is a record of the pressure during a single cycle of the engine. This does not in all cases give an accurate idea of what is being done, owing to fluctuations of load, and in such cases, instruments which make continuous records or diagrams are of advantage. As a rule these instruments are made so that the drum carries a roll of paper which is drawn around the drum and the diagrams overlap each other. By this means the load upon an engine is indicated continuously for several minutes, the complete record being some 12 ft. in length.

Indicators for internal combustion engines differ but little from those employed on steam engines; owing to the sudden and severe strains which occur, indicators for this purpose are usually made more substantial, with outside connected springs and smaller size pistons. In some cases indicators may be used interchangeably for steam or gas engines by merely changing the spring. Others have a simple method of changing the size of the cylinder.

For indicating air compressors, the ordinary steam indicator answers the purpose very satisfactorily, but when it is desired to indicate ammonia compressors, it is advisable to use an instrument made purposely for this kind of work as the ammonia gas is liable to attack the cylinder and piston of the ordinary steam indicator. Indicators for hydraulic machinery vary from the steam indicator principally in the matter of strength, but the steam indicator may be used for this purpose up to the maximum pressure for which it is designed.

When it is desired to take a number of diagrams from the same or different engines at the same instant, as during a test, the pencil mechanism may be operated either by the use of an electric circuit or by pneumatic appliances which hold the pencil against the drum.

THE AMERICAN-THOMPSON IMPROVED INDICATOR

THIS instrument, made by the American Steam Gauge & Valve Mfg. Co., employs the Thompson parallel motion for the pencil, with pivots made free from any appreciable lost motion, and will wear for an indefinite period. The force required to guide the lever of the instrument in its parallel movement is received on the pivot of the link alone. The pencil lever has a ratio of 3 to 1, and is constructed as light

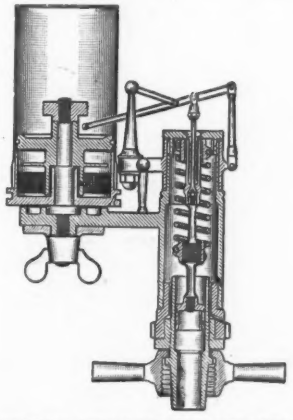


FIG. 7. AMERICAN-THOMPSON IMPROVED INDICATOR, INSIDE VIEW

as possible consistent with the work it has to perform. The paper cylinder movement is so constructed that the tension of the spiral drum spring within the cylinder can be increased or decreased for different engine speeds, thus providing for fine adjustment.

Connection of the piston with the pencil lever is made by a connecting rod having a crosshead at the upper end acting as a yoke, the top of the connecting rod being threaded permits the raising or the lowering of crosshead and forms a means of adjusting the position of the atmospheric line on the diagram.

The lower end of the connecting rod forms a socket which rests on the ball stud, and which is adjustable in the piston stem. This gives a ball and socket joint and provides means for taking up lost motion.

Bronze composition, which has a uniform expansion, is used in the construction of the cylinder. This is held securely at one end, having sufficient space

between the cylinder and outer casing to form a suitable steam jacket. Pressure springs are made of steel wire and wound on a mandrel, from 4 to 4½ threads to the inch, and thereby produce a spring which has a considerable freedom of movement. These springs are scaled, providing for vacuum. Close experiments, however, have shown that springs compress and elongate in unlike proportion, the regular pressure spring varying about 1 lb. in 30, or 3⅓ per cent.

These indicators are also made with outside springs which always remain cool and can be changed without removing the piston or allowing the indicator to cool. The spring is in line with the piston and operates in the same relative position with the piston as in the inside spring indicator. The piston rod and connections are made hollow and as light as possible to prevent error from the inertia of the moving parts.

THE TABOR INDICATOR

CHARACTERISTIC of the Tabor indicator, is the pencil movement which, due to its design, produces a vertical motion of the recording point, the velocity of which is always proportional to the piston movement.

A guide plate is substituted for the usual link motion and is rigidly secured in an upright position to the cylinder head and carries a curved slot which is engaged by a roller bearing pin secured to the pencil bar. This arrangement compensates for the tendency of the pencil to move in an arc and produces a straight line movement of the pencil.

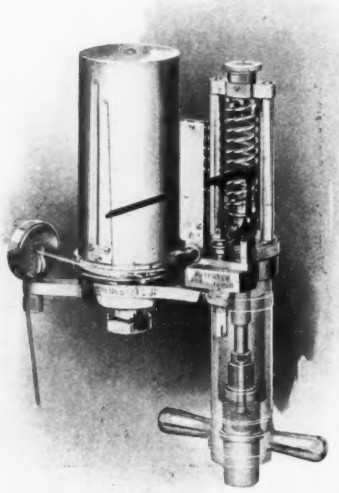


FIG. 8. COMBINED STEAM AND GAS ENGINE TYPE TABOR INDICATOR

Other features which are unique to the Tabor indicator are the pressure springs and the new improved piston. The former is of the duplex type, formed of 2 separate coils of wire of the same strength and pitch. These coils are attached to opposite sides of the spring mountings. This design, it is claimed, gives a better distribution of the stress due to service, and assuring a vertical position of the piston in the cylinder precludes the possibility of the piston jambing with a consequent scaring of the cylinder walls and excessive friction.

The piston is similar in general design to that heretofore used, but has deeply recessed rings for water packing and lubrication.

In addition to producing the Tabor indicator with inside spring, the Ashcroft Mfg. Company of New York make the instrument in outside spring form. No moving weight has been added, with consequent increased inertia effects, to secure the advantages of the outside spring type. In addition to relieving the spring from the deteriorating effect of the steam, this form admits of the quick change of springs without tools and precludes the necessity of taking the instrument apart to make the change.

As regularly produced for ordinary service, or for use on ammonia systems, the piston is of ½ sq. in. area. For gas engine and high-pressure work, however, a piston of ¼ sq. in. area is used, while with the combined steam and gas engine type both pistons are supplied and cylinders provided for their use.

LIPPINCOTT ENGINE INDICATOR

THIS instrument is made in 2 patterns, the inside and outside spring, the difference between these patterns being clearly shown by referring to the 2 engravings. The parallel motion of the Lippincott indicator is made of tool steel, with the joints hardened and ground, and with a special method of mounting the pencil motion, providing for adjustment in every direction.

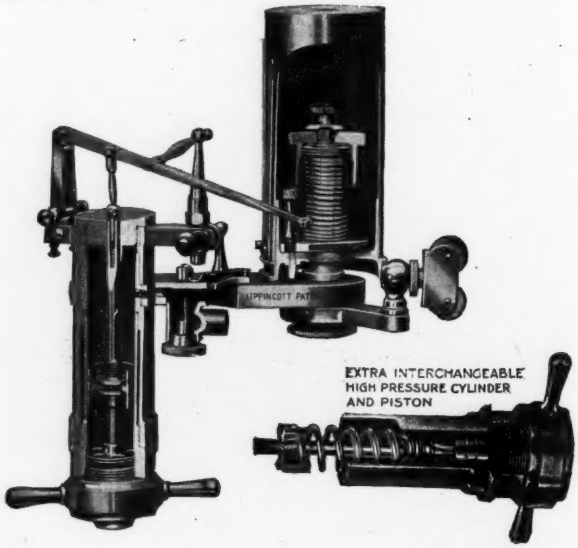


FIG. 9. SECTIONAL VIEW OF LIPPINCOTT HIGH-PRESSURE INDICATOR WITH SPRING REMOVED

The piston is also made of tool steel, hardened and ground, and is termed by the makers the frictionless piston, because it is provided with a patented tail bearing, the piston head being so made as to float, thereby centralizing itself, and preventing all metallic contact.

The steam jacket consists of an annular space between the inside working cylinder and the external casing, steam being admitted through a number of holes drilled in the working cylinder beneath the piston. This steam jacket is always filled with live steam, and drains itself at every stroke of the piston.

The piston spring is of the single coil type, made of steel wire. The heads are made of bronze, the bottom one being subject to movement, is made very light. The upper head has 4 wings grooved at the

proper angle to fit the wire, so that solder is used only to prevent unscrewing from the head, and not to resist compression. These springs are never ground during calibration, adjustment being made by screwing them into the upper head until they are accurate.

FIG. 10. LIPPINCOTT OUTSIDE-SPRING INDICATOR WITH REDUCING MOTION ATTACHED

A coil spring is used to operate the drum, it having in the upper head a square opening which fits over a square on the shaft, so that, by lifting this head slightly and rotating it, any desired tension of the spring may be secured, and by dropping it in place on the square shaft, the adjustment is made permanent.

The reducing motion, also shown in the cut, is provided with a cord take-up device, so that the cards may be changed without disconnecting the cord from the cross head. The instruments are made by Lippincott Steam Specialty & Supply Company, Newark, N. J.

IMPROVED ROBERTSON-THOMPSON INDICATOR

ANOTHER application of the Thompson parallel motion is made in the Robertson-Thompson indicator, made by Jas. L. Robertson & Sons. This is a standard size instrument with a piston ½ sq. in. in area, made of steel forming a light shell, which is provided with the usual water grooves. With each instrument an extra ¼ sq. in. piston is furnished, by means of which each spring may be used for pressures 4 times as great as the number stamped thereon. This extra piston is of especial value for hydraulic and gas engine work. Pressure springs employed are made of steel wire, the upper head being formed of special metal, having 4 wings with holes drilled to receive the coils. The final adjustment is made by screwing the coils in or out of this head to which they are afterwards firmly secured, no grinding being done in any case. The moving head is made as light as possible, as at this point lightness is of prime importance.

Each indicator is furnished with a stop mechanism or detent for the drum, ratchet teeth being cut in the bottom flange of the drum carrier and a handle provided to engage and disengage the pawl at will. This enables the user to stop the drum, to remove and replace the cards without disconnecting the cord from the engine.

By a convenient arrangement this instrument can readily be changed from right hand to left hand, by simply turning the movement on the swivel arm around and reversing the drum, thus adapting the instrument to any style of engine.

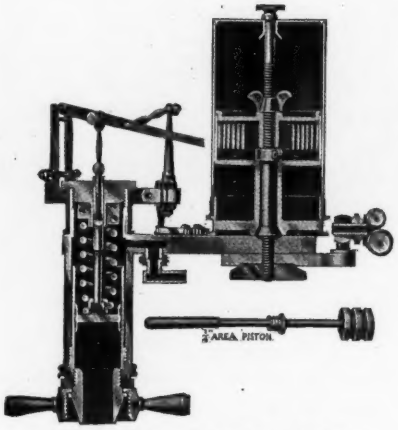


FIG. 11. SECTIONAL VIEW OF IMPROVED ROBERTSON-THOMPSON INDICATOR

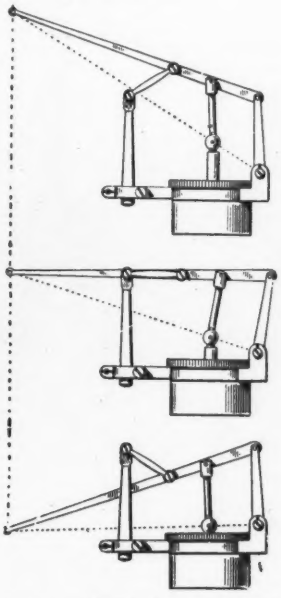


FIG. 12. ROBERTSON-THOMPSON PARALLEL PENCIL MOTION

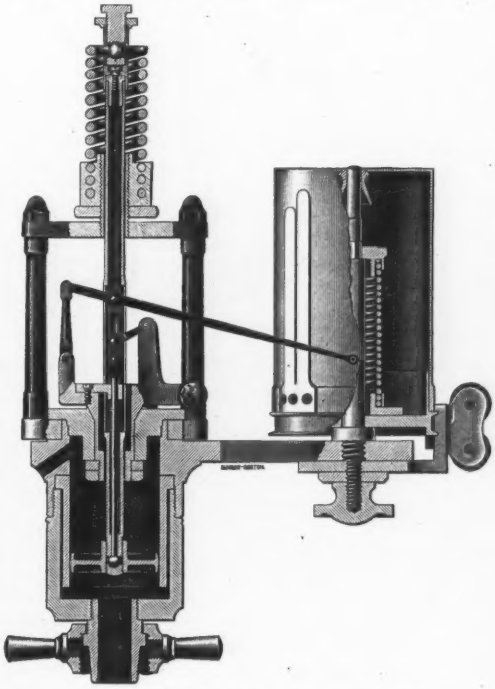


FIG. 13. CROSBY NEW INDICATOR

Another feature of the Lippincott indicator is the swivel elbow, which forms an outlet for the exhaust steam, and which may be turned in any direction instantly. The indicator is provided with an extra quarter-inch cylinder and piston of special alloy for ammonia, gas engine, hydraulic and other high-pressure work.

THE CROSBY NEW INDICATOR

THIS instrument differs from former Crosby types in that the location of the spring is outside the cylinder. Whatever error arises from heat therefore as effecting the spring in the enclosed indicator is not present in this. Another important difference lies in the size and shape of the piston, which is 1 sq. in. in area, thus providing great active force with a very light pencil mechanism. It is connected by a rod directly to the upper part of the spring, and moves freely and without restraint. The piston itself is a section of a sphere and serves as a universal joint to take care of the tortional strains of the spring when it

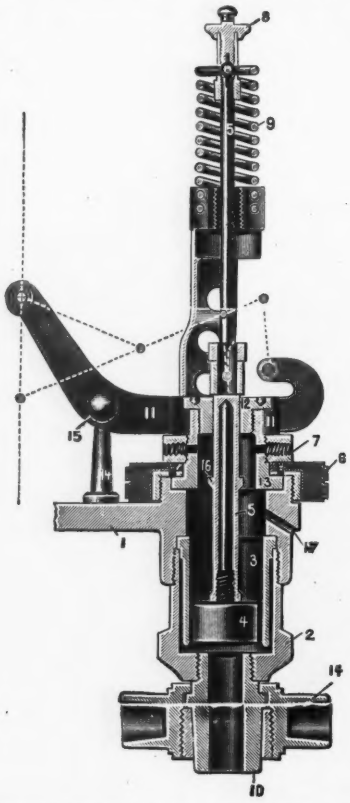


FIG. 14. OUTSIDE SPRING TYPE SCHAEFFER & BUDENBERG IMPROVED INDICATOR

operates the pencil mechanism of the indicator. The pencil mechanism is connected by a rod to and directly over the piston by a ball and socket joint.

This rod slides through a sleeve attached to the base of the pencil mechanism and moving in a vertical line compels the pencil to move also in a vertical line. Thus any motion of the piston due to the movement of the spring which causes the spring rod to deviate, will not affect the pencil mechanism in its vertical course.

The parallel motion of the Crosby indicator is peculiar to this instrument, and makes possible a very light mechanism. Another feature characteristic of the Crosby is the pressure spring, which is of the duplex type, one end being embedded in a head while the other ends in a bead to form a ball and socket joint.

The Crosby combination indicator for steam and gas engines has a cylinder which is adapted to receive 2 pistons of different diameters, adjusted as required. Another recent idea which has been adopted in the Crosby indicator is the provision of a drum carrying a roll of paper suitable for taking a series of diagrams.

SCHAEFFER & BUDENBERG IMPROVED ENGINE INDICATOR

THE body proper of this indicator supports the paper drum and the removable upper parts as well as taking the cylinder in its lower section. This cylinder is made of a special bronze metal and held securely in position by a sleeve. The latter also forms a steam jacket around the cylinder.

The piston spring is made of a single piece of spring steel wire, wound in a double coil, the ends of which are securely fastened into a bronze base. The latter is threaded for connecting to the indicator while the top of the spring has firmly attached to it a small steel bead which takes the place of a brass head. In attaching the spring to the indicator, the bead slides into a slot provided in the upper end of the piston rod. The spring is then screwed down on the bridge and secured on top by a thumb screw.

The drum spring is coil shape, accurately made of spring steel wire. The paper drum is made of aluminum, and is 1 13/16 in. in diameter, thus adapting the indicator for high speeds but answering equally well for low speeds.

The parallel motion is a modification and improvement on the Thompson motion, adapting it for an out-

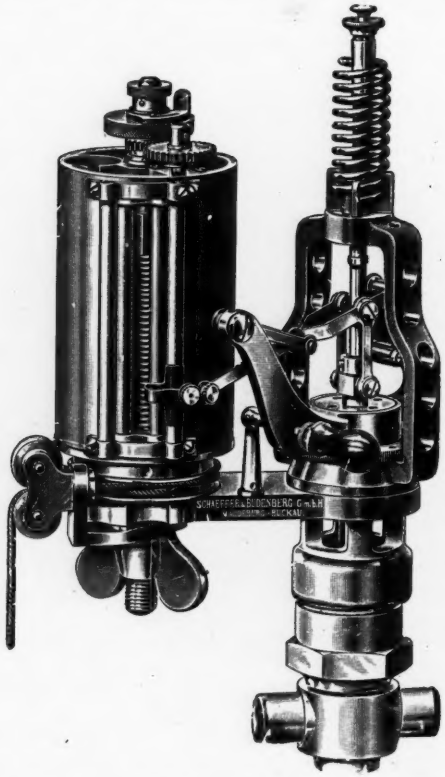


FIG. 15. CONTINUOUS CARD INDICATOR

side spring which facilitates the manipulation of the indicator, making the spring more accessible and permitting a change while the instrument is hot.

For conditions where the load changes rapidly the continuous card indicator has been introduced. The distinctive feature of the continuous card indicator is that a roll of paper instead of a card is carried upon the card drum which is drawn forward during the exhaust stroke of each cycle, thus giving a series of cards which overlap each other.

USE AND CARE OF THE INDICATOR

VARIFYING ADJUSTMENTS AND SUCCESSIVE STEPS IN TAKING CARDS

IN using and caring for this instrument it should be remembered that it is a delicate piece of apparatus with small parts and carefully fitted bearings, and that in order to retain its accuracy it must be protected against injury. A blow or fall may result in springing the pencil motion or the adjustment of the paper drum so that the record made is not correct. And any scoring or cutting of the piston or cylinder surfaces may cause leakage which will seriously affect the diagram.

It is essential therefore that in handling and using the indicator it should be treated as a delicate piece of fine and accurate testing apparatus and not as a piece of heavy machinery for rough work. Care should be taken in attaching it to the engine that all dirt is blown out of the connecting pipes before the indicator is attached, that the indicator is properly oiled and cleaned, that it is protected from dirt and grit getting into the bearings, that excessive pressures are not applied to any springs, and that the paper drum is not banged against the stops at either end of its motion.

Size of Card

IT is desirable, in order to get as clear a reading as possible, to keep both the height and length the greatest consistent with accurate record. For high speed a long card is likely to produce inertia at the end which will make the drum over-run. This can be partly overcome by tightening the drum spring, but this again produces whipping of the cord, which will cause error. Lengths that are desirable may be taken for an average as 100 r. p. m. and below, 4 in.; from 100 to 200 r. p. m., 3.5 in.; from 200 to 400 r. p. m., 3 in.; 400 to 500 r. p. m., 2.5 in.; 500 to 600 r. p. m., 2 in.

Height of the card is governed by the same considerations, and also by the allowable compression of the spring. As a rule the spring should be so chosen that for low speeds the card will be about 2.5 in. high, for moderate speed about 2 in. high, and for high speed about 1.5 in. high.

It is well in attaching the indicator to take out the spring and pencil motion and leave them in the box until after the instrument is on and the cord length adjusted. The length of the cord should be such that the drum will not strike on either stop. The bearing of the paper drum spindle should be carefully oiled and it should be made certain that the drum is running smoothly with no hitch at any point of its motion.

Steam should then be blown through the cylinder of the indicator and a drop of carefully filtered cylinder oil applied to the indicator piston. Ordinary oil filtering should not be depended upon, but the cylinder oil should be carefully strained through 2 or 3 thicknesses of gauze and a small bottle of this filtered oil carried for this special purpose. The piston spring and pencil motion may then be inserted, and it should be noted that the drum is adjusted so that the paper clips will not strike the pencil point. In all modern indicators there are 2 positions of the drum, one for right hand motion, the other for left.

The pencil should be adjusted with a short lead, and with a fine smooth point, and the pencil stop so arranged that it will give a light fine line on the diagram. The paper for diagram should have a smooth, even surface, and, if printed, the impression should not be forced through the diagram so as to make elevations which will catch the pencil point Drum tension should be as light as possible and still keep the cord always firm.

After making sure that everything is properly placed and adjusted, the indicator cock is opened, and the action of the pencil watched. By putting the finger on the top of the piston rod it can be ascertained whether the pencil is rising and falling steadily and without irregular jumps. The indicator should then be closed and the atmospheric line drawn, after which the indicator cock is opened, the diagram taken, the cock closed, and another atmospheric line drawn to verify the first one.

If valve adjustment is being tested, a single diagram is all that is needed, but if horsepower is desired, several strokes may well be indicated to get the average power developed. About 10 revolutions of the engine is the desirable number.

Data Needed

DATA which should be recorded at the time that the card is taken, are as follows: date, time, name of plant, make of engine, type of engine, if in a series the number of the card, which cylinder, which end, boiler pressure, r. p. m., length of stroke, diameter of cylinder, diameter of piston rod, scale of spring, vacuum by gage, steam jacketed or not, jet or surface condensing, temperature of injection water, of hot water, type of valve gear, character and amount of load.

If for a gas engine the number of expansions per minute should be taken, the gas consumption in cubic feet per minute, the amount of ignition gas consumed, pressure of gas on the meter in inches of water, the quantity of jacket water per minute, and the initial discharge temperatures of the jacket water.

For air compressors the additional data should include the barometric pressure, pressure at the intercooler, pressure at the receiver, quantity of circulating water, temperatures of the atmosphere, of the air inlet and outlet, and of circulating water inlet and outlet.

For low-speed engines and moderate steam pressure 10 diagrams may be taken before again lubricating the piston; for high speed and pressure oil should be applied twice as often; while in the case of gas engines the piston should be oiled every 2 diagrams because of the high temperature dealt with.

Whenever possible, the indicator should be so adjusted that the arm which carries the paper drum points in the direction of the lead of the indicator cord. Sometimes it is not possible to do this, but if it can be so arranged, the strain on the parts of the indicator is less.

In putting the paper on the drum, care should be taken that the 2 ends are even at the bottom edges so that the card will set square on the paper. The paper should be drawn around the drum smooth and even and, if a thin paper is being used, the ends should be bent back over the paper clips to keep the card in position.

Tests for Condition and Accuracy

IRREGULARITIES most commonly encountered are friction of the piston in the cylinder, friction in the pencil motion due to springing of some of the parts, lost motion in the pencil motion due to wear, bending of the arm which carries the paper drum or of the

spindle so that the paper drum is not parallel with the indicator cylinder.

Irregularity in the pencil motion may be ascertained by placing the finger on the pencil lever near the back fulcrum. If irregularity is found, it may be due to friction in the cylinder or in the joints of the pencil motion.

The indicator should be taken from the engine and the spring removed. Put the piston in the upper part of the cylinder with the thumb covering the opening at the base through which steam enters; holding the cylinder vertically the piston should fall very slowly toward the bottom while the air escapes past the piston. If it will not do this both cylinder and piston

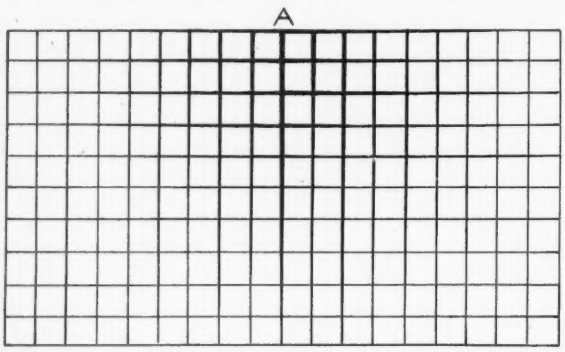


FIG. 1. CROSS LINES WHICH SHOW TOP OF DRUM SPRUNG TOWARDS POINT A

should be carefully cleaned, using a piece of gauze or tissue paper rather than waste.

If the surface of piston or cylinder has become slightly scored, they should be freely lubricated and a spring inserted, weak enough to allow the piston its full travel. Disconnect the pencil motion and allow the instrument to run under steam for a short time which ought to remedy the slight scoring and secure the desired freedom of movement. No grinding material of any kind should be used.

If the piston is found to be working satisfactorily, the pencil movement should be examined. When held vertically, the pencil lever should drop freely to its lowest position after being raised and released. If any tendency to jerk is noticed, the joints should be examined and the levers tested to make sure that none are sprung.

Next put the instrument together without the spring, raise the pencil lever and close the opening at the base of the cylinder by the thumb as in the case of testing the piston. With the instrument held vertically the whole of the moving parts should descend slowly so long as the thumb is held on the opening, but more rapidly than when the piston alone is in the cylinder. When the thumb is removed the piston should fall instantly to the lowest point in the travel.

Lost motion may be detected by putting in a fairly strong spring and then testing for backlash at the outer end of the pencil lever. If lost motion is found, the joints of the pencil movement must be examined separately, also the attachment of the collar which carries the pencil movement.

Stiffness in the pencil movement may be due to gumming in the joints. This can be overcome by soaking the movement in kerosene, and, if this is not effective, by taking apart the pencil motion and cleaning all the bearings.

If it is found that the line made by the pencil is not of even thickness at the top and bottom as the pencil is moved vertically, or around the cylinder as the cylinder is revolved, it means that the drum spindle is out of parallel with the indicator cylinder. This can be tested by putting a fine point on the pencil, adjusting it until light can just be seen between the pencil point and the paper, and first moving the pencil up and down and afterwards revolving the cylinder with the pencil stationary. By watching the daylight between pencil and paper it can be seen where and by how much the variation is.

By using the ratchet on the drum, vertical lines may be drawn at different points around the cylinder and by holding the pencil at different heights and rotating the barrel slowly, horizontal lines may be drawn at different heights. In this way the amount of the distortion of the barrel and direction may be located, Fig. 1.

Another test is to allow the piston to fall to its lowest position, then revolve the drum with the pencil at rest, giving a horizontal line, then revolving the drum half way, turn on steam and allow the pencil to make a vertical line. The paper may then be removed from the drum, and the lines tested to see if they are at right angles, by the method of equal arcs, Fig. 2, or by the use of a tested right angle triangle.

Springs should be tested from time to time to make sure that they are accurate, although with careful use the spring is the least likely of any part of the indicator to get out of order, provided it was properly

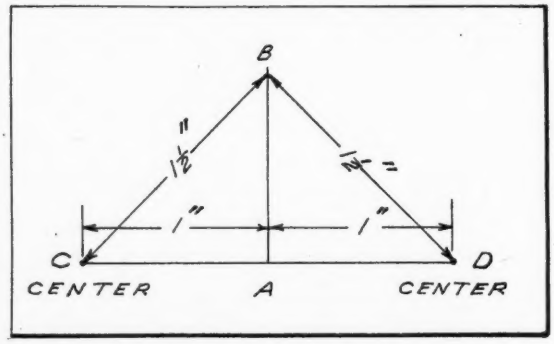


FIG. 2. TEST FOR ANGLE OF LINES; IF ARCS CROSS ON LINE A B THE LINES ARE PERPENDICULAR, OTHERWISE NOT

made in the first place. For this test either a special testing apparatus for indicators, or a chamber in which the pressure may be regulated and to which a standard test gage may be attached will be necessary. A spring should be tested at different points throughout its compression, or in the case of a vacuum its tension, to make sure that the motion is uniform at all points and that the spring registers correctly under all conditions of vacuum or pressure.

As much of the testing around the power plant depends upon the indicator, it is essential that it should be dependable, and this involves that it be made accurate, second that it be carefully used, third that it be kept clean and properly adjusted.

THE ANNUAL per capita fire waste in the United States is $2.51, in Europe 33c. Cause: The latter has better construction, less carelessness, increased responsibility.

"LITTLE THINGS will make you big in the estimation of your customers and employers."

WHAT THE INDICATOR SHOWED

GETTING ACCURATE ADJUSTMENT BY STUDY OF SMALL VARIATIONS

By Geo. H. Wallace

ALL too frequently one encounters conditions hard to believe unless seen, and this is especially true in the line of steam engineering. In many instances it is believed that a large number of elbows, tees and valves in a steam line do not interfere to any great extent and also that steam used for industrial purposes taken from the main does not reduce the steam pressure at the throttle.

Several years ago the writer had the opportunity to observe at close range an instance of this kind, and as it gave me considerable pleasure in securing the evidence, I present it to Practical Engineer readers and hope that they may be benefited also.

Having been sent to a large manufacturing establishment in a neighboring city to erect an engine "to help out the old one," I was naturally inquisitive as to what the old one was doing, and had occasion to watch it struggle with the load fully half the time without cutting off.

From a general observation of conditions and the load carried, it did not impress me as being too much of a load for an engine of that size and with the steam pressure carried, so when I was invited to apply the indicator "just for fun" one day, while waiting for the belt gang to complete its work on the new engine, I accepted with considerable promptness, and the cards are presented here with the full explanation of the various changes as they were made.

The engine in question was a Vilter, right hand, girder frame, single eccentric engine, running over and belted to a line shaft which drove the usual assortment of wood working machinery. The cylinder was 15 by 30 in. at 86 r.p.m., scale of spring 60. The steam pressure will be noted on the various cards. It just so happened that through the breaking of some of the machinery part of the usual load was off at the time, and we were also fortunate in being able to shut down and make whatever adjustments were required without much inconvenience.

Upon applying the indicator, the first card secured was Fig. 1, there being 90 lb. steam pressure on the boilers at the time. There seemed to be so much drop in pressure according to the scale that I looked the instrument over carefully and took several more cards, but all showed the same drop. As one of the boilers was new, with a new gage and the gages agreed, there seemed to be no reasonable doubt about their accuracy.

Believing that there was a cause for this effect, I traced out the steam pipe. It was a 4-in. pipe at

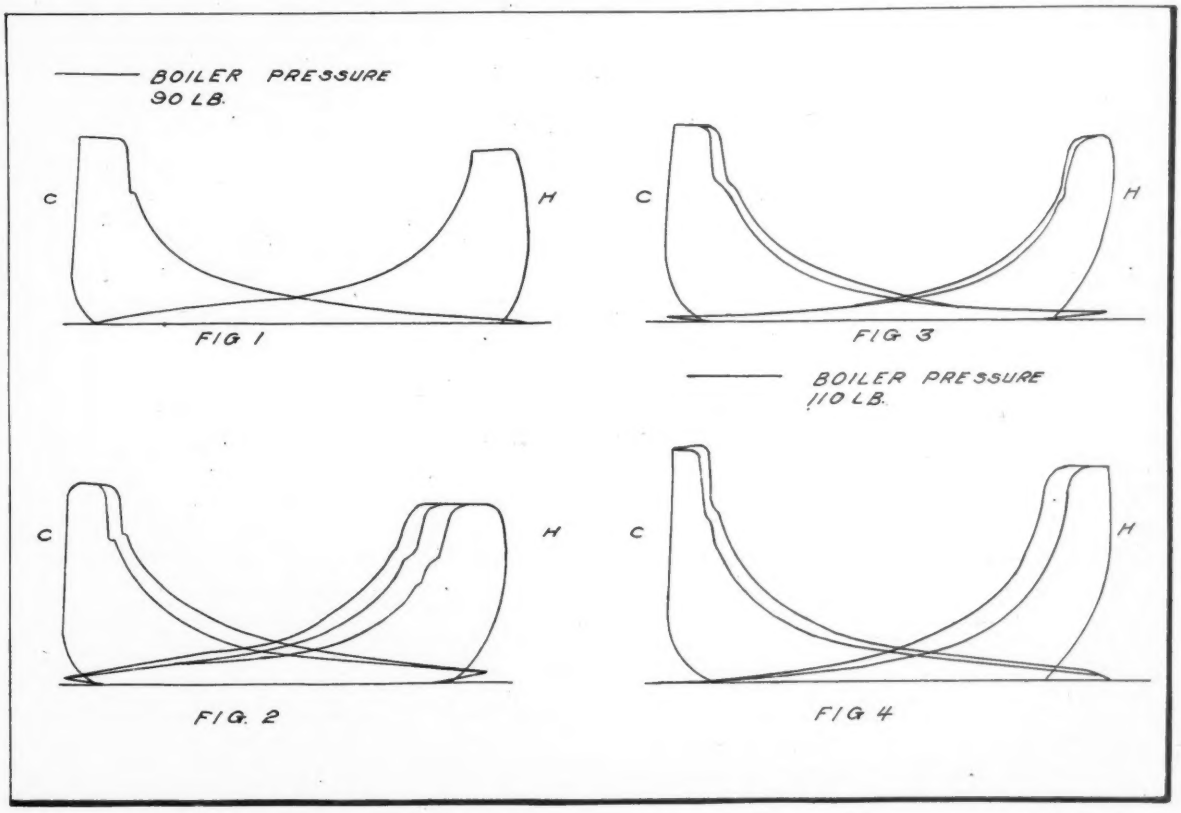


FIG. 1. THE FIRST DIAGRAM TAKEN
FIG. 2. AFTER ADVANCING THE ECCENTRIC

FIG. 3. AFTER SHORTENING THE ECCENTRIC ROD
FIG. 4. ECCENTRIC ROD STILL FURTHER SHORTENED LARGE DROP FROM BOILER PRESSURE

the throttle valve, but at the second of the elbows it was reduced to 3½ in., both boilers being piped into this 3½-in. header, and all uncovered. Between the engine and the first boiler and close to the latter were 2 tees, one 2-in. and one 2½-in., using live steam for 2 dry kilns, steam heat and a fan engine.

Right here was the reason that a new engine was required to help out the old one. But in addition to the drop in steam pressure other defects were apparent and we proceeded to remedy them.

After taking the card in Fig. 1, the eccentric was moved ahead on the 7-in. shaft 5/8 in., to bring all events earlier in the revolution, which gave us Fig. 2. This card shows that the peculiar hook on the expansion curve of the crank end of Fig. 1 is beginning to disappear and that the different events are earlier; but as the wrist plate over-traveled the marks on the wristplate stand, the eccentric rod was shortened about 1/8 in., when we took the card shown in Fig. 3 with 95 lb. steam.

The hook on the crank end card is gradually being eliminated, and in order to equalize the various events as nearly as possible, the eccentric rod was shortened 1/16 in. more, so that the wristplate traveled to the marks; we then took Fig. 4, the steam pressure being 110 lb. at the boilers, yet the card scales only about 80 lb. initial pressure.

As there was too much difference in compression, we lengthened the exhaust rod at the crank end and shortened the exhaust rod at the head end. The effect of this is shown in Fig. 5, which indicates that the same procedure can be repeated to advantage.

After taking Fig. 5, we shortened the steam rod at the crank end to reduce the lap and increase the lead and lengthened it at the head end to increase the lap and reduce the lead, the drop rods being adjusted as required. It will be noticed on this card that the irregularities of the expansion lines have practically been eliminated and completely so in Fig. 6, which was taken with 110 lb. steam.

Drop in the steam pressure at the engine is still present, Fig. 6 scaling about 90 lb. The same process was repeated after Fig. 6 as after Fig. 5, with the result shown in Fig. 7, which shows a very fair card. This card was taken with a little block placed under the governor standard and the governor held down on it just at the moment of taking the card, the object being to ascertain the relative point of cut-off on the 2 ends of the cylinder with the governor stationary. Figure 7 shows that the cutoff is later on the crank end than on the head end, so the knock off rod on that end was lengthened while the one at the head-end was shortened.

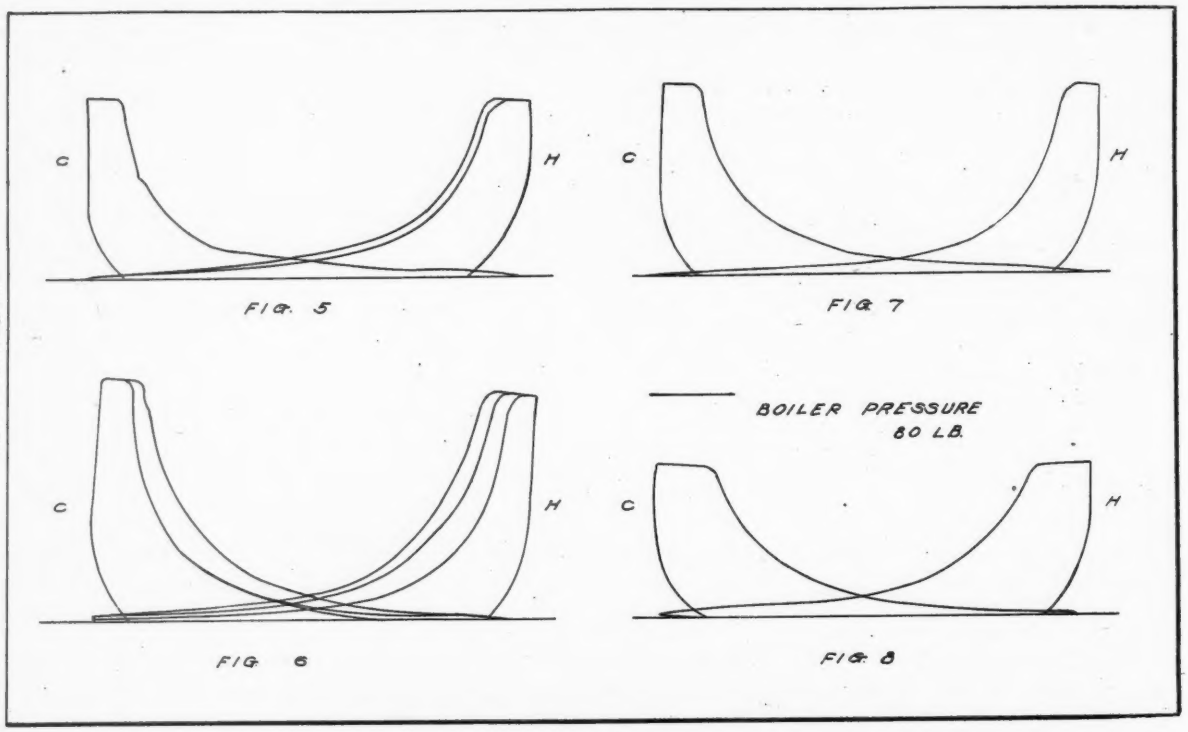


FIG. 5. COMPRESSION PARTIALLY EQUALIZED BY CHANGING LENGTH OF EXHAUST RODS
FIG. 6. HEAD END LAP INCREASED AND LEAD REDUCED; CRANK END LAP REDUCED AND LEAD INCREASED
FIG. 7. FURTHER ADJUSTMENT ALONG THE SAME LINES. GOVERNOR HELD STATIONARY
FIG. 8. KNOCKOFF RODS ADJUSTED TO EQUALIZE CUTOFF

These adjustments having been made we took the card shown in Fig. 8 with 80 lb. steam pressure.

Several more were taken under the same conditions and feeling that the adjustments were as good as could be had, we called it well enough. It seems that the connections between the engine and boilers had been put up in opposition to the engineer's wishes. In fact he was over-ruled in the matter, and the work was done by a "millwright" whose ignorance on such matters was only too evident, and the result was the expense of an additional engine sooner than it would have been required had the job been done right in the first place.

UNUSUAL CARDS AND THEIR CAUSES

IT is always a delight to an engineer to secure a perfect card from his engine; by perfect is meant one which is typical of perfect operation of the class of engine indicated. The interest taken, however, is just as keen, perhaps more so, when an unusual card is procured.

The first step to be taken when a card out of the ordinary is secured, is to examine the instrument and all its attachments before trying to make any corrections in valve setting or other adjustment of the engine. A study of cards taken with faulty indicator and connections will reveal that many of the hooks and curves characteristic of poor valve setting are produced, and thus mislead the novice and frequently the wiser men.

Faulty Connections

ONE of the most common causes for an unusual card is too long pipes connecting the indicator to the cylinder. The resulting card would be similar to that shown in Fig. 1, which, were the indicator connections proper, would signify too late admission. This, however, is not the case as the steam admission is correct

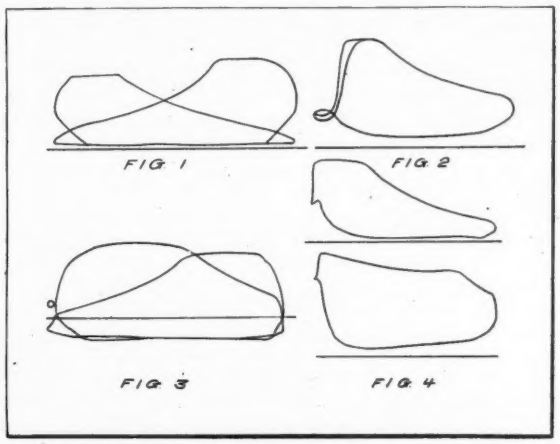


FIG. 1. INDICATOR PIPE CONNECTIONS TOO LONG
FIG. 2. ORIFICES TO PIPES CLOSED AT ENDS OF PISTON STROKE
FIG. 3. SLIDE VALVE LATE IN ACTION
FIG. 4. LEAKS INDICATED BY COMPRESSION LINE

in time in both ends of the cylinder, but the piston seems to be moving too rapidly for the steam to attain its proper initial pressure.

It sometimes happens that the indicator is connected by a short pipe to one end of the cylinder while the other connecting pipe is run full length of the cylinder. In this case one of the diagrams would appear as shown in Fig. 1, while the other would be perfect. From these 2 examples it evidently is necessary that for real accurate results an indicator be connected directly to each end of the cylinder, cards being taken simultaneously from each end.

Another fault in connecting indicator pipes to the cylinder is to have the orifices in such a place that they are partly closed by the piston at the end of each stroke. The effect of this sort of connection is shown in Fig. 2, where a loop is formed in the compression line of the card. The lowering of pressure thus indicated is partly due to leakage past the piston of the instrument of a portion of the steam confined. With higher speeds this loop becomes flattened more, as shown by the outer line Fig. 2, and in some cases amounts to only a point or hook.

Compare Fig. 2 with the diagram shown in Fig. 3, which contains a loop due to the slide valve being too late in its action. The similarity is so great that the cause of one may readily be mistaken for that of the other.

Somewhat similar diagrams are shown in Fig. 4, and were caused by a leak from the compression space. This, however, is usually more pointed than a loop, and its cause is therefore more readily discerned.

The effect upon the card of introducing tees, valves, etc., in the pipe connections is to reduce the indicated pressure, the same result being obtained when the indicator cylinder is exposed and excessive condensation takes place. Another source of error is due to water in the indicator cylinder, caused by priming or condensation, the resulting card is an unusual one with wavy steam and expansion lines.

Except in extreme cases it is difficult to detect, from the card, errors due to pencil motion, paper drum, springs, cord, or reducing motion. Any defects in these parts should be corrected when the instrument is calibrated before being put into service.

Faulty Diagrams Due to Valve Settings

ONE of the common errors in valve settings is to have the admission too late. Cards which indicate this defect are shown in Fig. 5, the first example being taken from a Corliss and the second from a slide-valve

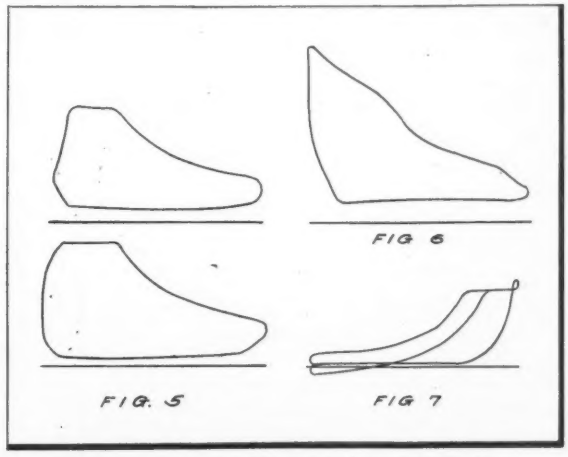


FIG. 5. CARDS INDICATING LATE ADMISSION
FIG. 6. EXAMPLE OF THROTTLED STEAM
FIG. 7. LOOPS DUE TO EARLY CUT-OFF AND COMPRESSION

engine. In the card from the Corliss engine, it will be noted, this event is the only one in the cycle which is defective, and is caused by the valve being misplaced or badly set. In the other card all events are late as well as admission, so that the remedy is to advance the eccentric on the shaft.

In Fig. 6, is shown the effect of throttling during admission. The steam line drops instead of being horizontal, indicating that the steam port is not open for a sufficient time.

An odd but quite commonly procured card is that shown in Fig. 7, which is due to the cut-off and com-

pression occuring too early in the stroke. The steam expands until its pressure is less than the back pressure, and the expansion line crosses the back pressure line to form the loop shown at the left. Such a card is frequently obtained from automatic cut-off engines working on light loads, the cause being too high steam pressure, to light load or too high speed. By correcting any one or all of these, the cards can be bettered as shown by the card with the upper expansion line obtained when speed was reduced and cut-off made later.

One of the most valuable uses of the indicator is to show up leaky valves or piston. If the expansion

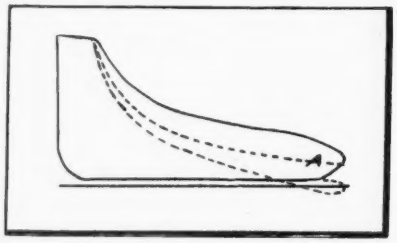


FIG. 8. INDICATIONS OF LEAKS

line is noticeably above the theoretical adiabatic expansion line shown at A in Fig. 8, the indications are that steam enters the cylinder through a leaky valve after cut-off. If the expansion line falls below the

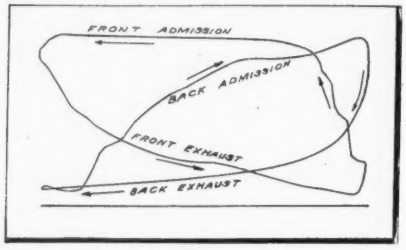


FIG. 9. EXTREME CASE OF LEAKS

theoretical, steam leaks past the piston or gets out through a leaky exhaust valve.

As a horrible example of leaks, Fig. 9, is shown. The engine which produced this card was 42 years

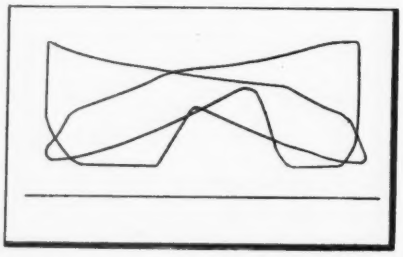


FIG. IO. EFFECT OF REOPENED VALVE

old and was a simple, horizontal, double-acting, noncondensing engine, with an ordinary D slide valve. A Watt governor controlled the admission of steam by throttling, and the cylinder was 12 in. in diameter by 24 in. stroke. Neither the steam chest nor the cylinder was lagged; the slide valve was loose on its spindle, the play being about 1 in.; hence the extremely late admission. Upon removing the back cylinder cover it was found that a space ⅛ in. wide existed about 1/3 the way around between the piston ring and the cylinder walls.

Another exceptional diagram is that shown in Fig. 10, which was taken from the high-pressure cylinder of a compound, horizontal, tandem steam engine with ordinary D slide valve. The admission of steam at both ends commences promptly, but it continued throughout the greater portion of the stroke. The exhaust opens and closes at either end in accordance with good practice, but also closes and re-opens in mid stroke. Examination showed that the steam lap allowed to the slide was too great and the travel of the valve was also excessive. After the steam port had been opened the continued movement of the valve caused the lap to bridge across the exhaust port, thus temporarily preventing the escape of steam from the opposite end of the piston.

INDICATOR MOTION FOR WESTINGHOUSE ENGINE

By S. E. Balcom

THE object of an indicator motion is to give an exact reproduction of the motion of the piston of an engine to the drum of an indicator, on a reduced scale. With engines which have a piston rod and crosshead, this is not difficult, as a reducing wheel, pantagraph or other like arrangement attached directly to the crosshead of the engine, which crosshead has of course the same motion as the piston, will give the same motion to the indicator drum.

With a Westinghouse or other engines which have no crosshead, however, the case is different. There is no way to attach anything to the piston so that the mechanism is required to be designed and attached to the end of the shaft which extends through the governor wheel. This may be done in an approximate manner by fastening a small crank pin to the end of the shaft and running a long connecting rod up to the top of the engine, or simply a wire from the pin to the indicator, and connect that to a lever which will get an up and down motion somewhere near the motion of both pistons, but not accurate enough for anything but setting the valve.

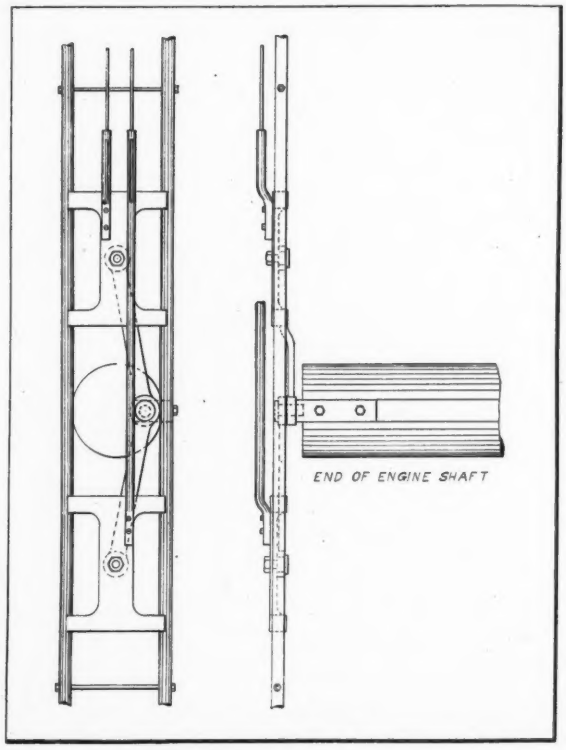
We wished to have an accurate reproduction of the motion of both pistons, so thought at first that it would be necessary to have 2 cranks, one for each engine crank, but by running the crossheads opposite each other, one crank sufficed. We set 2¾-in. cold rolled rods vertically at the end of the engine to act as guides for our crossheads, fastening them at the top and bottom and bracing them through the middle. The crossheads were made of cast iron, which probably will be changed to aluminum later to save weight, and were cast wide enough so that the ends could be drilled by a ¾-in. drill and then the ends of the casting sawed off so as to leave half of the hole in the crosshead to come against and slide in the guides. The crankpin was made out of a square piece of steel which was machined to fit the keyway in the end of the engine shaft, the end sticking out beyond the shaft being turned down to ¾ in. diameter for the pin. This piece of steel was offset toward the center enough to make the pin travel in a circle 3½ in. in diameter which was the length of the card which we wished to take. This keyway in which the piece of steel was fastened is on the same side of the shaft as the piston on one side of the engine, in this case it is the high-pressure piston of a compound engine with cranks 180 deg. apart, and it is supposed to be exactly with it.

The connecting rods were made so that the ratio

of their length to the length of the crank of the reducing motion was the same as the ratio of the length of the rods and crank of the engine, thereby correcting for all angularity of the connecting rods.

For the same reason 2 crossheads and 2 connecting rods were used, one for each piston, the one for the high-pressure piston being above the shaft, and that for the low-pressure piston running underneath the shaft which gave the same effect that running 2 cranks 180 deg. from each other and the crossheads both on top would have given, and which simplified the construction and made it easier to take down and replace, which has to be done quite frequently in this place. The connecting rods were made of wrought iron, and the ends bored out and babbitted and generous oil holes drilled in them. The pins being large, no trouble was experienced by their wearing or heating. The guide rods are adjustable to take up wear sidewise.

It then, of course, remained to transfer the motion to the indicator which of necessity was some distance away from the crossheads. Strings stretch too much to use them for very long distances, and wires are too awkward, so that sliding rods were attached to the crossheads and run to the top of the engine, to these



INDICATOR MOTION FOR WESTINGHOUSE ENGINE

were fastened adjustable pins. From these pins we ran ⅛-in. wire rope over carrier pulleys up to 2 more sliding rods at the indicator and to which we could hook the indicator at will. The vertical sliding rods were made with a clutch at the lower end so that they could be stopped when the engine was running while the crossheads run all of the time.

The accompanying sketch will show the general appearance of the apparatus.

EXPERIENCE IS an intangible asset, is always dearly bought, but nevertheless full value for outlay."

POWER LOSS OF SLIPPING BELT

ONE often sees discussed the question whether or not a slipping belt is less economical of power than one which does not slip. If we consider that when a belt slips friction occurs between the pulley and belt, thus creating heat, it is at once seen that part of the driving power is "lost," as the radiation of this heat attains no useful end.

The approximate amount of this loss may be obtained as follows:

A motor delivers 10 hp. to a line shaft by means of a 6-in. double leather belt, running 2000 ft. a minute.

The accompanying sketch shows the belt tension T to be 300 lb. on the tight side, while the tension T_1 on the slack side is 135 lb.

The average belt tension T_2 will be about half the sum of the other two, or about 218 lb.

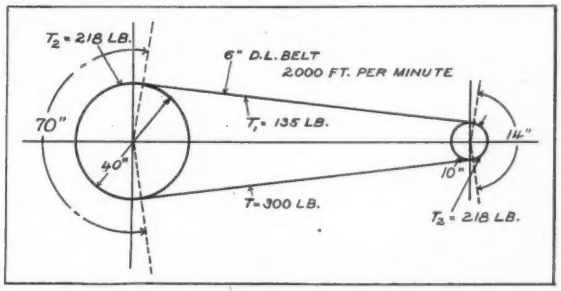
The tension in the walls of a thin cylinder, due to a uniform pressure, is equal to the product of the unit pressure multiplied by the radius of the cylinder.

Conversely, since the average belt tension at the pulleys is 218 lb., the average belt pressure per inch length of contact with either pulley is equal to 218 lb. divided by its radius in inches.

This amounts to 11 lb. for the large pulley and 44 lb. for the small one.

Since the lengths of belt contacts are 70 in. and 14 in. respectively, the total pressure of the belt on the large pulley is 770 lb., and on the other 616 lb.

If the total belt slip be 10 per cent, the slip on the motor pulley will be about 6 per cent, or inversely proportional to the total belt pressure. A 6 per cent slip on the motor pulley amounts to 120 ft. per minute.



BELT TENSION AND ARCS OF CONTACT

If the coefficient of friction of leather on iron is 0.2, then the grip of the belt on this pulley amounts to 616×0.2, or 123 lb.

The loss of work is then 123 lb., multiplied by 120, or 14,760 foot-pounds per minute. In like manner the belt slip on the large pulley being 4 per cent, the pulley rim travels 80 ft. a minute slower than the belt. The grip of the belt on this pulley is 154 lb. and the energy lost per minute is 80×154=12,320 foot-pounds.

The total energy lost in this drive due to a 10 per cent slip of the belt is then about 27,000 foot-pounds per minute, or ⅞ hp. In this calculation centrifugal force on the belt has been neglected.

It would thus seem that the proper remedy is to have the belts so tight that slippage will be reduced to the minimum. (Some slip is necessary, since without it there is no friction between the belt and pulley and no power can be transmitted.)

On account of excessive strains in shafts, bearings and belts, the better solution would be to use a reliable belt dressing and run the belts as slack as possible with little slip.—The Phoenix.

FIRING STEAM BOILERS

By M. J. Conlon

BOILER firemen as a rule are men who have hard, laborious work and, in some cases, very exacting. In a great many cases their pay is not in proportion to what they are worth. A good fireman is of great value to the plant, because the coal pile is an expensive item and it is there that the poor or wasteful fireman can put more coal to waste than would pay for an intelligent, capable man.

Some firemen are good only at certain kinds of boilers and under certain conditions, because they never take the trouble to find out if any other way would be better than the one they have learned. That is why you see some really good firemen only a few days in a new plant, because the conditions are not the same as they were where they left. Always find out the best way and then practice it, and if a man does change his place he will have no difficulty in getting used to the system in vogue. But firemen usually have nothing to say about what kind of boilers the owner of a plant installs or what kind of coal he will use. The intelligent fireman who has to deal with the different grades of fuel and knows best how to handle them and how to get the most heat out of each kind and under all the different conditions, that man is in demand and a power plant owner who knows anything about his worth will not let him go and take on a cheaper man.

Coal

AS I said in the first place coal is the most expensive item the manufacturer has to deal with. In large plants where they have a large coal pocket it is sometimes divided into several different compartments and in each of these compartments there may be a different grade of coal and perhaps no 2 grades cost the same a ton delivered at the pocket. In such plants the good fireman with experience can make his work easier than the man who has used only the one kind for the whole year, because it requires different handling in order to get best results out of it, as some will give best results when fired thinly on the grates and others will require a reasonably heavy fire, some coal requires wetting down before firing and to others it is detrimental. It requires experience to know what to do with each kind.

The question may be asked: What good does it do coal to have it wetted down before firing? If the coal is fine and a good strong draft is employed the light particles are drawn over the bridge wall when a shovelful is thrown on the fire, and some coal will not coke up like others. When the fireman is fixing his fires he often finds some of the fine coal passing through the grates unburned and it is this kind of coal that is benefited by the wetting. Such coal should be fired light and often, then there will be no need for the slice bar at all.

There is an objection to wetting down the coal, as all the water that the wet coal contains when it is thrown on the fires must pass off as vapor, this mingled with the unburned gases causes a thick cloud of dark smoke to emerge from the stack which would mean poor combustion. But for all that with a good draft it is better to wet that grade of coal and then to fire it thinly and evenly so as to necessitate little handling in the furnace.

Grates

GRATES, like the boilers, are too frequently chosen without consulting the fireman who must take what he gets and make the best of it. He should see that the kind he has got are properly fitted both at the walls and next to each other, as any large opening between the bars will allow the coal to drop into the ashpit, and if fitted too tightly they will warp and make it hard for the fireman when slicing, raking or cleaning his fires. I like the shaking grate very much and think it superior to any of the others if it is properly secured after each operation by the attendant.

Dampers and Draft

MANY power plant owners do not understand nor realize the need of a good draft and when approached on the matter by the fireman pay no attention to what he has to say and merely shake their heads and say the other fireman found no fault. Perhaps he did but was afraid to speak. It is less expensive to install a forced draft system than to build a stack 200 or 250 ft. in height.

With forced draft almost any kind of coal can be burned in the furnace, the steam pressure kept a great deal more even, the fireman will not have to work so hard and in most cases a saving will be noticed in the amount burned. By forced draft I mean a fan that supplies air to the furnace at sufficient pressure to overcome the resistance of the grates and the bed of fuel. It is operated by a shaft or an engine with a regulator to shut down when the steam reaches the blow-off point and to start up when the steam is needed, that is automatic regulation.

Some firemen believe in closing the ashpit doors to regulate the draft but I consider this bad practice. The stack damper should be used instead, for it is necessary that some air should pass through the bed of fuel in order to burn the gases. If the plant is equipped with the necessary appliances for analyzing the gas there is no doubt in my mind but that the fireman will adopt a system whereby he will not burn so much coal, have less smoke, maintain a steady steam pressure and in general secure better firing and more economy.

Cleaning Fires

THIS is done in many ways but the best way that I have found is to clean one side at a time, when there is a great demand for steam and it must be done in a hurry. When fires need cleaning build a strong fire on one side and let the other burn out, when burned push all the good coals to one side and pull out all clinker and ash and throw the good fire back on the grates and add some fresh coal and do the same with the other side; in this way you can keep up the steam and your fires will be properly cleaned.

Some firemen clean the front half of the grates first and then jump the clinker over the hot fire and by the use of a hoe work the ash through the grates and spread the fire as before. Either of these ways is good and it is for the fireman to decide which is the better.

Cleaning and Inspecting Boilers

A FIREMAN may be able to make good use of the coal in the boiler room and not be able to clean his boilers properly. As the cleaning of the boilers is of great importance, it should be done at regular inter-

vals in a systematic way and if the work is well done it means a longer life for the boiler and less fuel for each pound of water evaporated. Oftentimes a careless fireman injures the boiler by his method of cleaning. When a boiler needs to be cleaned it is cut out and the steam pressure allowed to drop down, to say 10 lb., it is blown out and filled with hot water, not cold, and then tubes cleaned and its setting cleaned and examined for any little cracks, if any are found they should be filled as any cool air entering around the boiler reduces its heating value and also the temperature of the furnace.

With the tubing clean and all holes and cracks in the setting stopped, draw off the water from the boiler and take off the hand-hole and man-hole covers, then with a light make an examination of the inside of the boiler. With a small scraper and a hose enter the boiler and give the inside a thorough cleaning and examine all stays, braces, tube ends, back head, along the fire line, crown sheet, and see if there are any of the plates pitted, if so notice if they are worse than on the previous cleaning, examine around the blow-off and see if it needs replacing. Report all defects that may be found and await the orders from the superiors before firing again.

Cutting in Newly Fired Boiler

THIS is the most hazardous thing a fireman has to perform and some of them think lightly of it. Every steam user knows that the opening of a valve on the line releases pressure and is liable to cause serious rupture. It is not so dangerous when the pressure is nearly alike on both sides of the stop valve. A good way to cut in a newly fired boiler is to get up steam until the safety valve starts to blow, then notice the pressure indicated by the steam gages and if not alike start the pump and get the pressure down to the same point as the other boilers supplying the steam main, then open the stop valve slowly and there will be no shock that would cause a rupture or any serious trouble.

COAL VALUES AND PRODUCTION

INTERESTING facts are brought out by the United States Geological Survey, in regard to the coal resources of the country and the remaining coal resources. Under the present system of classification of Government lands, up to August 1, 56,089,214 acres have been withdrawn from the public lands and classified as coal bearing land. These lands are found to contain workable coal beds, aggregating 16,873,370 acres, and have been appraised in 40-acre tracts at a total valuation of $711,992,537, at prices ranging from the minimum of $10 or $20 an acre, according to whether the land is within 15 miles of the railroad or not, to over $400 an acre, where the thickness of the coal beds ranges from 60 to 100 ft. or even more. The values given compare well with those asked for the private coal lands in the same vicinity, and although $400 an acre may seem high as compared with $30 an acre for which the lands might have been bought a few years ago, when it is considered that for a 40-ft. coal seam there are 72,000 tons of coal to the acre, or for a 100-ft. seam 180,000 tons, the price asked seems insufficient, inasmuch as an 80-ft. seam of coal at $400 an acre is a price of less than 3c a ton. At the minimum prices which were in effect before the change in classification, the valuation of the lands given above would have been only $266,652,431, so that there has been saved to the public revenue $445,300,000 and over, by the new classification.

During 1910, Indiana's production of coal was 18,389,000 tons, valued at $20,813,659, or a gain of over 3½ million tons over 1909. The price of Indiana coal was on the average $1.13 a ton as against $1.02 in 1909, and the total value of the coal produced increased 37.34 per cent over the previous year.

Pennsylvania has been increasing its anthracite output, the quantity in 1910 being 75,400,000 long tons, an increase of over 3,000,000 tons above the preceding year. The average price at the mine in 1910 was $2.12 against $2.06 in 1909, $2.13 in 1908, and $2.14 in 1907. By the use of grates and furnaces adapted for burning small sizes of anthracite, the percentage of waste has been reduced to a minimum, so that buckwheat, rice, barley and even culm are now important steam fuels, particularly for hotels, apartment houses, and large office buildings. In fact, the unsightly stacks of culm which heretofore have been everywhere in the anthracite region are fast disappearing, and the usable coal is being reclaimed by a washing process.

During 1910, 4,184,629 tons of fuel were recovered from the old culm banks, and 99,833 tons were recovered by dredges from the bed of the Susquehanna River.

On the Pacific Coast the fuel requirements are of special interest because of the agitation in regard to development or non-development of the Alaskan coal resources. At the present time, consumption of coal on the coast is not large, and the successful operation of coal mines in Alaska will depend on prices being attractive to the manufacturing industries. Oil is the principal manufacturing and railroad fuel at the present time, about 15,000,000 barrels of California oil being consumed by locomotives in 1909 as against a little over 18,000,000 barrels for 1910. The oil displaced during 1910 between 11 and 12,000,000 tons of coal. For the Pacific coast, the state of Washington is the principal source of coal, as the output of both California and Oregon is at the present time small. In 1910 the production of coal on the Pacific coast was 3,903,983 short tons in Washington, 62,707 tons in Oregon, and 11,164 tons in California. Bituminous coal was imported amounting to 752,046 tons, and anthracite 9,116 tons.

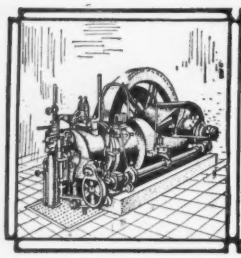
At the present time coal is being shipped into Alaska, in 1910 the importation being 98,420 short tons, of which 8,178 tons were from British Columbia and 15,877 tons from Washington. The production within the territory was reported at 1000 tons, or only about 1 per cent of the consumption.

IN THE N. Y. World is given an amusing instance of an unusual engineer's difficulty in securing supplies:

"Chief Engineer William Richmond of the steamer Asbury Park, the Central New Jersey's Sandy Hook line, ordered a tub of Albany grease, which has a golden yellow color, to lubricate his engines. Richmond raised a row when he did not get the grease, then learned that it had been delivered.

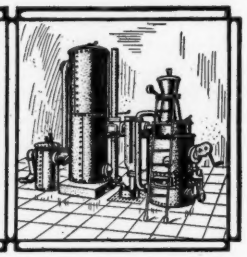
"The steamer was searched high and low; at last the tub nearly empty was found in a corner of the chef's ice-box. William Richland, the chef, had read the 'Richmond' on the tub as 'Richland,' and had mistaken the grease for butter he had ordered.

"Many Wall Street lawyers and brokers who have summer homes on the Jersey shore commute on the boat and often have meals aboard. But no complaints about the butter have been brought to the chef for a week."



Gas Power Apparatus

Producers, Engines and Industrial Applications

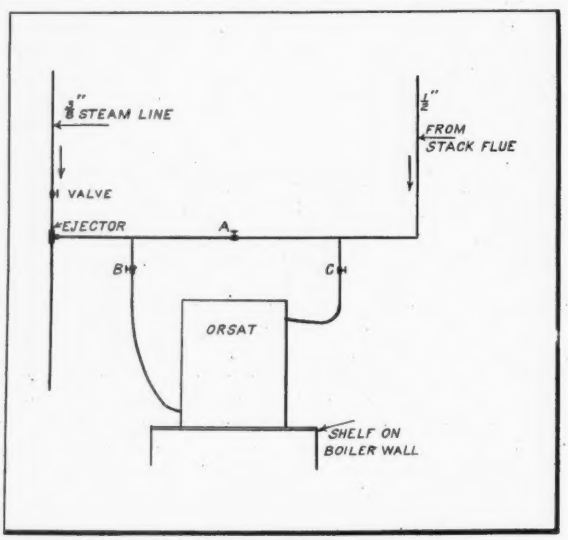


TESTING PRODUCER GAS

By J. O. Benefiel

IT is a necessity in the manufacture of producer gas, if the man in charge is to have any knowledge of the results he is getting, to analyze the gas more or less completely. We analyze twice each day for CO_2,O, and CO with an occasional test for hydrogen and methane.

We use the Orsat for the first 3 and an explosion burette connected to the Orsat for hydrogen and methane, the whole outfit cost about $32. We find that the Orsat, as usually used, does not remove all the CO by about 2 per cent, therefore when testing for hydrogen, after exposing the gas to the cuprous chloride reagent in the pipette in regular use until it shows an absorption of 0.2 or less, it is passed into a pipette containing fresh reagent to remove all the CO possible, otherwise the methane test



CONNECTIONS FOR GAS ANALYSIS INSTRUMENT

would be in error owing to the combustion of the CO in the explosion tube and the absorption of the products of this combustion when removing the CO_2 due to burning the methane. We are always somewhat suspicious of a high showing of methane and therefore take all precautions.

It is rather confusing in figuring the heat value of the gas to find one authority giving the heat value per cubic foot at standard temperature and pressure for CO, 322 B.t.u.; H_2, 324; CH_4, 1021; another for H_2, 345; CO., 341; CH_4, 1065; still another for H_2, 347; CO, 342; CH_4, 1072.

The best gas we have ever made contained CO_2 4.4 per cent, CO, 27.4, H, 13, and CH_4, 3.2, with an average for a week of CO_2, 6.4 and CO, 23.4 per cent.

Some beginners with the Orsat do not seem to realize the necessity of making the absorptions in their proper order, the gas should always be passed into the caustic potash pipette for carbon dioxide absorption first, next to the alkaline pyrogallol pipette for absorption of oxygen, third into the cuprous chloride pipette for absorption of carbon monoxide, the gas being returned to the measuring burette after each absorption to find the percentage of each constituent of the gas removed.

Some authorities say to use oxygen in exploding the hydrogen, but we observed that the professor of chemistry from one of our leading universities in testing the gas at this plant used air and after a little experimenting we found the proportion that would give us a good explosion and do not see why we should not get as accurate results with much less trouble, of course there is some inaccuracy in our results but in comparing them with the more accurate methods of the professor we found that the errors balanced each other and our analysis figured close to the same heat units as the professor's. The proportion of air to residue of gas we found best was 40 c. c. of air to 35 of gas.

In testing boiler flue gases we used the arrangement shown in the sketch, this avoids exposing or bringing the gas in contact with water, which will absorb the CO_2 and give erroneous results. To use this we set the Orsat on the shelf as shown, turn on the steam and draw the gas through until we are satisfied all the air is out, then close valve A and open valves B and C and the gas will be drawn through the Orsat. The whole affair is mounted on the side of the boiler setting.

Speaking of forced draft before the Franklin Institute, Henry G. Brinckerhoff says that where the height and area of the stack are both inadequate and outgrown, the introduction of forced draft requires a fierce blast to overcome the resistance ahead of the gases and force them out to atmsophere, thus sometimes producing such a force against the boiler front as to become uncomfortable or dangerous every time the doors are opened for coaling.

Forced draft requires either a good draft at the other end, or, paradoxically, none at all, but a short spacious path to out of doors. Where forced draft works too strenuously against the boiler front and it is impossible to keep up steam with a lower air pressure, either vent should be provided after leaving the boilers, or the chimney draft improved by adding induced draft.

If boilers are of the water-tube type, there is another remedy which might be worth trying, namely removing the bafflings; the heat, as shown by the conditions of pressure around the front, will in such cases, be as efficiently brought in contact with the heating surfaces without the baffles.

GAS ENGINE WHYS

By C. E. Strait

In a recent issue of Practical Engineer I noticed an article by H. W. Jones in which he laments that the gas engine profession is being neglected by the leading engineering schools. In the same article he says, "Go into any of these schools and find a modern up-to-date gas engine if you can, one that is up to date in construction and equipment"

In reply, I wish to state that either Mr. Jones is misinformed or uninformed as to the real facts concerning this subject. Let him spend a half day in the gas engine department of Purdue University and he will find all that is up to date and practical in gas engine operation and equipment. As an example of what may be found there I will make mention of a few representative types: A 20-hp. horizontal, 4-cycle Fairbanks-Morse gas engine which runs on either gasoline or kerosene, slight changes only being necessary to change the engine from operating on gasoline to kerosene. A 25-hp. Otto engine operating on city gas. A 50-hp. Fairbanks-Morse vertical, 4-cycle engine operating on producer gas. A 20-hp. Merrian Abbot engine operating on city gas, and several 2 and 4-cycle automobile engines operating on gasoline, also a small I. H. C. engine the horsepower of which the writer is uninformed. Besides this equipment provision is made for the testing out of any engine that may be sent to the university.

All of the above mentioned engines are equipped with prony brakes and the mechanical efficiency, thermal efficiency, i. hp. and b. hp., pounds of cooling water per horsepower-hour, etc., are determined. Let the author ask any questions he may desire as to the proper equipment of a gas engine, but do not let him forget to state at the same time under what conditions the engine will be required to operate, and an answer will be forthcoming from any of the graduates of this school who have taken the gas engine work.

Again the writer wishes to call attention to the fact that not all consulting engineers have failed to recognize the superiority and usefulness of the gas engine as a generator of power. Take for example the large number of gas engines utilizing blast furnace gas at the Gary plant of the U. S. Steel Co. Does Mr. Jones think for a minute that these engines were installed at an enormous expense without the consulting engineers having something to say about it? The gas engine has its field, and in its field is unsurpassed, but outside of its field is more out of place than the old simple non-condensing steam engine, which, too, has its place of usefulness.

In the field of gas producer engines the fact that it is hard to find competent men to handle the gas producers and consequent unsuccessful operation of the engine due to either quality or quantity of gas, may account, in a way, for hesitation on the part of consulting engineers to recommend this installation. When the points of difficulty are overcome (and large strides are being made in that direction) the gas engine field will have its proper place in the list of power factors.

It seems strange that the basis of aluminum which we know as a soft metal should at the same time form the basis for an abrasive; but the new material, Corubin, which has recently been put on the market consists of practically pure alumina with a trace of chromium oxide.

BLANCHARD OIL ENGINE

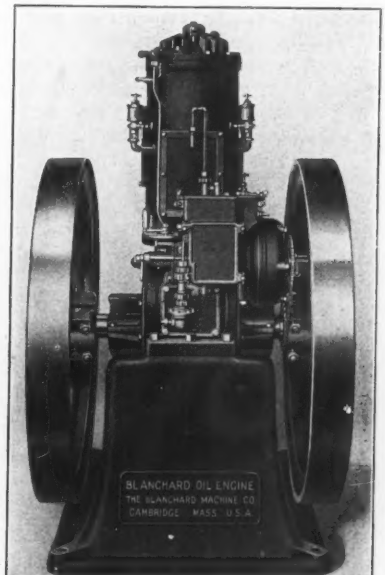
This is a distinctive new design of internal combustion motor operating on kerosene, crude and distillate oils, produced by the Blanchard Machine Co., from designs of Wolcott Remington, who has had more than 10 years' experience in this line.

This engine is built for stationary and marine service, in sizes ranging from 8 to 100 hp. and with from one to 4 cylinders.

Accessibility of parts is one of the features, with all working parts of the engine entirely enclosed and self oiling so that the engine and the engine room are easily kept clean at all times.

The Blanchard engine receives an impulse for every revolution, and is, therefore, of the 2-cycle type, but the fuel is taken into the cylinder only after all ports are closed, the air has been compressed, and the engine is ready to receive the impulse, so that this engine has all the theoretical advantages of the 2-cycle engine.

On the up stroke, the piston uncovers a port admitting air to the closed crank case. On the down stroke this air is compressed slightly and then is transferred through ports to the cylinder above the piston. On the next up stroke this air is compressed and just before the end of compression the fuel is atomized into the cylinder by a pump.



THE BLANCHARD OIL ENGINE

The finely atomized oil is turned to a gas by the heat of compression, then instantly ignited by coming in contact with a plug, located in the head, and kept hot by the heat of the burning fuel. The pump which atomizes the oil is so driven that the oil is equally well atomized at all speeds of the engine, an important point in marine engines which must be capable of running at reduced speeds.

Practical tests have shown the fuel consumption of the Blanchard oil engine to be not more than 0.1 gal. per brake horsepower per hr., the actual figures depending on the analysis of the oil used. At less than full load the economy of the Blanchard engine approximates very closely the full load economy.

The atomizing nozzles of the Blanchard engine are thoroughly water jacketed so as to prevent the formation of carbon on their interior and the resulting stopping up of the small opening through which the oil must flow.

Quick starting has been accomplished by using a small thin tube which can be heated to a red heat in less than 3 min. Then the first charge of oil is pumped into the cylinder by moving a lever connected to the fuel pump; next compressed air is admitted from a small storage tank and the engine starts. After the engine has been running a few minutes, the burner is extinguished.

Blanchard marine oil engines are equipped with air compressor, water circulating pump, reverse gears and compressed air burners. These compressed air burners use kerosene oil and give a blue flame of very high temperature the instant they are lighted, so that the engine can be under way 3 min. after the match is lighted.

MILLER IMPROVED GAS ENGINE

DURING the past 2 yr. the Miller Improved Gas Engine Co. of Springfield, Ohio, has developed a 4-cycle gas engine which is composed of twin cylinders in sizes from 50 to 190 hp. and above 190 hp. to 400 hp. double opposed twin cylinders. It is constructed with a heavy duty frame built for moderate speed with compression in accordance, and by the arrangement of the cylinders an impulse is given to the shaft at each revolution in the twin cylinder type and each half revolution in the double opposed twin cylinder type. The bed is of a well braced box construction arranged with oil drains which carry all excess oil used in lubricating the engine bearings to the bed beneath the crank pins.

All the cylinders are water jacketed in such a manner that the strains due to heat of the cylinder are not communicated to the water jacket and the danger of bursting the cylinder and cracking the head is eliminated.

The pistons are sufficiently long for 4 snap rings. Each has pins in the grooves placed spirally to keep the joints of the rings in position in the bottoms of the cylinders so that the ribs of the pistons between the rings will break joints and prevent leakage. The rear ends of the pistons are turned tapering to allow for expansion on the explosive end. To prevent blowing through, a lap joint ring is used on the pistons.

By the use of cross heads and guides it is possible to use a much shorter and lighter piston than with any other construction. By this means the wear and friction of the piston and cylinder is greatly reduced and the wear can be taken care of with cross heads and guides. The cross head wrist pins are forged steel while the guides are machined and finished all over and the bearing surfaces hand scraped. The arrangement is such as to prevent any waste of oil which, as stated above, is drained to the bed beneath the crank pin.

Adjustment for wear of the cross head shoes is easily taken up since these are made in sections. They are swivelled on the ends of the cross head pins to insure perfect bearing their entire length.

For the pillow blocks the quarter box type is employed and so arranged that adjustment for wear can be taken care of by means of wedge plates. The main shafts are made of hammered open hearth steel, being straight and without shoulder offsets to cause friction or fractures. The cranks are of cast steel, bored, shrunk and keyed on the ends of the shafts and at the same time, while the cranks are hot, the wrist pins are inserted into their sockets and are secured when the cranks shrink.

The exhaust valves are vertical and mechanically operated. They are of the poppet type, balanced by pistons equivalent to the area of the valve; this relieves the mechanically operated parts of all strains, as the pressure in the cylinder has no effect in offering resistance. The inlet valves are also of the poppet type, mechanically operated. The 4 valves at each end of the engine are operated by 3 cams within an oil filled case, the cams and rollers being of hardened steel.

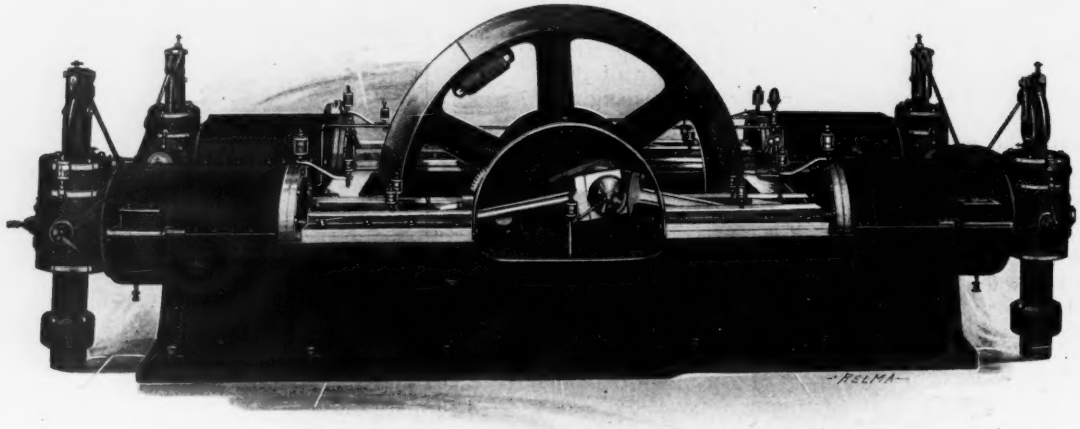


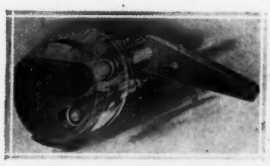
FIG. I. SIDE VIEW MILLER IMPROVED GAS ENGINE

Ignition of the gas is obtained by the use of a high-tension magneto of such a design that the engine may be started automatically from the magneto without the use of a battery or coils, the jump spark method of ignition being employed. The position of the spark is changed when starting by the use of a safety arrangement which prevents ignition below the center when the engine is being started. Upon starting, the magneto spindle is caused to stop by a hardened steel trip engaging a trip lever, thus winding

a spring on the magneto spindle during 20 deg. of the engine shaft rotation. By this time the trip is automatically turned out, causing the armature to impulse suddenly ahead, thus developing sufficiently large current across the spark point to cause ignition. When the engine speed gets to about 30 r.p.m. the spark is advanced automatically to the point of best operation.

The speed of the engine is governed by varying the quantity and quality of gas mixture, and for controlling the speed a Jahns governor is employed which maintains a regulation from no load to full load within 2 per cent, and in many cases this is reduced to 1¼ per cent.

An improvement in the spark plugs used is a noteworthy feature, since by this arrangement it is possible to renew the spark plug without in any way interfering with the operation of the engine. This type of plug is also of advantage in determining any spark difficulty which may be noted in operating the engine. When throwing the lever to its extreme point in either direction, the firing plug only is exposed to the combustion chamber, the other plug being shut off by the valve, and the operator is enabled to determine, when having ignition trouble, whether it is in the plugs or elsewhere.



3. SOOT AND MOISTURE PROOF SPARK PLUG

These engines are started with compressed air and this is accomplished automatically by opening 1 valve, causing admission and discharge on the air-starting cylinder, at each turn of the flywheel tripping the inlet valve and shifting the secondary exhaust cam entirely automatically.

SOME OPERATING DIFFICULTIES

AN interesting discussion took place at the meeting of the Internal Combustion Engineers Association of Chicago, held November 13. One of the members had reported "after firing" in a Nash gas engine which had troubled the operating force for a considerable time, and complaint had been made by neighbors who objected to the noise produced by the engine. The engine is of the standard Nash type, with exhaust connection and piping in conformity with good practice. The operator of the engine reported that he had reduced the amount of cylinder oil in the crank case, and had, in this manner, relieved the situation materially, but for fear of overheating the cylinder, he is reducing the oil gradually and reports a continual betterment in the operation.

The question arose as to what was the real cause of the "after firing." The operator stated that no fouling of the ignition point was noted, and that the cylinder itself and all passages appeared perfectly clean. It was suggested that perhaps the deposit of carbon in the exhaust pipe and valves became heated during exhaust and, retaining its heat, caused the difficulty. Another suggestion was that the cylinder oil used was too light for this purpose and, evaporating during the exhaust stroke, due to the heat of the cylinder, formed an explosive gas which caused the after explosion.

Another member of this association, who sells gasoline engines, reported the embarrassing position that magnetos that he had sold under guarantee of perfect operation to supplant batteries on gasoline engines, had given considerable trouble to his customers by not igniting the gasoline when the engine was first started. These magnetos furnish alternating current to a make-and-break ignition circuit, and are supposed to ignite the gas at the first half turn of the engine. He reports that the insulation is of the best obtainable in the market.

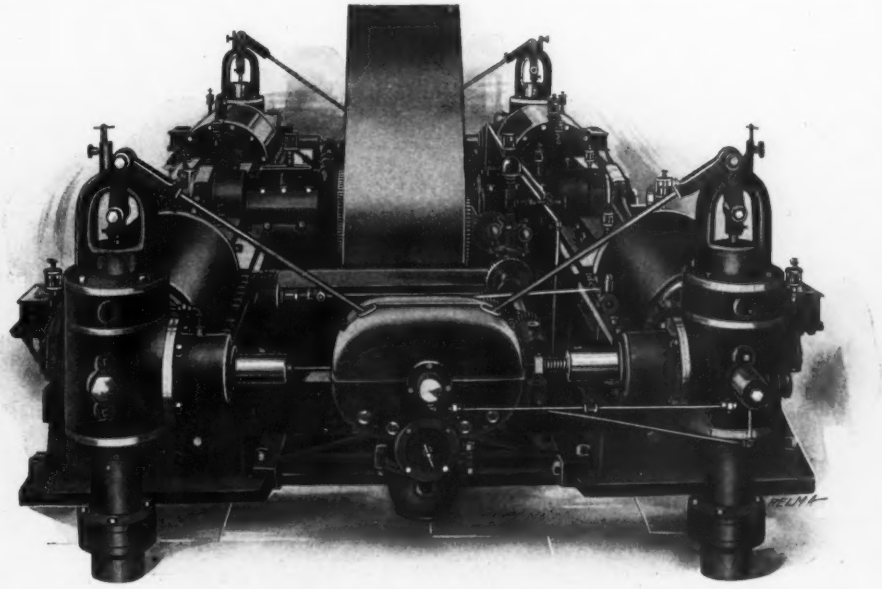


FIG. 2. END VIEW OF ENGINE SHOWING VALVE OPERATING MECHANISM

The only plausible explanation which was given for this operation was that the cylinder in the morning was cold and perhaps the igniter points had accumulated a sufficient amount of moisture in the night to form a short circuit between the points. It was also suggested that perhaps the coil itself had accumulated moisture which, becoming dry after the engine had been in operation a short time, would render the magneto perfectly insulated.

These are problems relating to the practical operation of gas and gasoline engines, and their solutions would be of interest to readers of Practical Engineer.

BELT CONVEYORS

CAPACITY, POWER AND COSTS

By Reginald Trautschold

FIRST consideration in any conveying system is naturally that of capacity and this depends largely upon the speed at which the conveyor is run. Without going into a detailed discussion of this important question, it may be stated that small coal is carried most economically on a belt conveyor at a belt speed of about 400 ft. a minute, lump or run of mine coal at 250 ft. and ash at about 300 ft. per minute. The capacity of the common sizes (widths) of belt conveyors handling such materials at their respectively best speeds is given in the Practical Reference Tables. Such speeds, however, permit a certain variation without sacrificing economy of operation to any great extent and capacity will, of course, vary directly. One other point must be borne in mind when choosing the size of the conveyor, and that is that bulky coal should always be carried on a wide belt irrespective of capacity. For instance, it is impossible to convey economically run of mine coal on a belt less than 30 in. wide, unless special loading facilities are provided, and even then a 24-in. belt is the minimum efficient width.

Power

IN the matter of consumption of power, the belt conveyor is very economical. One horsepower is all that is needed to carry one ton of coal or ash a horizontal distance of nearly ⅞ of a mile or all that is required to convey 45⅔ tons 100 ft. An inclined conveyor, however, uses more power, about 4⅔ times as much being required to elevate as to convey a corresponding horizontal distance. An inclined conveyor is also limited to a comparatively gradual grade, an inclination of 20 or 21 degrees is about the steepest practical angle. Another operation requiring power is that of discharging the load from the belt at any point other than the end of the belt. This may be accomplished by means of an automatic tripper, a tripper moved by hand or by an arrangement of carrying the upper belt around 2 pulleys so as to form an S-shaped kink, known as a fixed dump. The power required for either of these 3 methods is very nearly the same. Formulae I, II and III give the actual horsepower that is consumed by a well-constructed belt conveyor, carefully installed and in good working order, when operated at the desirable speed for its load. Formula IV gives the horsepower that is required for each discharging device, belt conveyors 12 to 36 in. in width inclusive, in excess of that required to carry the maximum load on the conveyor.

Horsepower Required to Operate Belt Conveyors

When handling fine coal at 400 ft. per minute.

$$\text{Hp.} = \frac{(0.0396w^2 + 0.077W)L}{1000} + \frac{WH}{1000} \qquad \text{Formula I.}$$

When handling lump coal at 250 ft. per minute.

$$\text{Hp.} = \frac{(0.02475w^2 + 0.077W)L}{1000} + \frac{WH}{1000} \qquad \text{Formula II.}$$

When handling ash at 300 ft. per minute.

$$\text{Hp.} = \frac{(0.0297w^2 + 0.077W)L}{1000} + \frac{WH}{1000} \qquad \text{Formula III}$$

Horsepower Required for Each Tripper or Fixed Dump Discharge

$$\text{Hp.} = \frac{w - 10}{8} \qquad \text{Formula IV.}$$

w = width of belt in inches.
W = weight of load conveyed in tons per hour.
L = length of conveyor in feet.
H = height in feet lifted.

Initial Cost

OWING to variations in quality, one belt conveyor may cost 100 per cent more than another, but for powerhouse work, where an installation is to be permanent, it is economy to purchase only the best apparatus. The best belt for the work is one of the rubber type with an extra rubber cover for resisting the abrasive wear of material slipping and to protect the fabric of the belt from damage due to shock of receiving the load.

To derive the cost of a belt conveyor equipped with such first-class belt and other parts of equally high grade, the equipment may be divided into 2 groups; one including end pulleys, driving machinery, necessary bearings, shafts and collars, and the other including the belt and idlers. Table I gives the approximate cost of the equipment necessary for a high-grade belt conveyor for handling coal or ash, expressed in terms of maximum load that can be conveyed in tons per hour at the most efficient speed for the material carried. The table makes no allowance for the power unit, as this is a question depending entirely upon local conditions.

For conveyors to be run at other than the given speed, the cost of the apparatus will vary inversely as the speed, or if the belt is not destined to carry its full load the cost will increase in the same proportion as the capacity decreases and vica-versa. The variation in cost per ton capacity for conveyors handling coal and ash is proportional to the weight of the 2 materials.

Table I. Approximate Cost of Belt Conveyors and Discharging Devices

Belt Conveyors

When handling fine coal at a belt speed of 400 ft per minute.

$$C = 0.04695WL + 0.5775W.$$

When handling lump coal at a belt speed of 250 ft. per minute.

$$C = 0.07512WL + 0.924W.$$

When handling ash at a belt speed of 300 ft. per minute.

$$C = 0.07233WL + 0.8555W.$$

Where:—
C = cost of equipment in dollars.
W = capacity in tons per hour as given in the table of capacities.
L = length of conveyor in feet.

Discharging Devices

Automatic tripper.

$$C = 11.8125w + 141.75 + 0.85T.$$

Hand tripper (steel frame).

$$C = 6.67w + 79.71 + 0.85T.$$

Fixed dump.

$$C = 2.1w - 12.3.$$

Where:—
w = width of conveyor belt in inches.
T = length of tripper track in feet (total travel of tripper).

Operating Cost

NET operating cost may be considered as consisting of: 1st., cost of operation, including expense for power, labor and miscellaneous supplies necessary for the economical operation of the system, such as lubricants, etc.; 2nd, cost of maintenance, including depreciation of apparatus, renewal of parts, etc.; and 3rd, burden, represented by interest on the initial outlay, taxes and insurance. The sum of these expenses being the actual net operating cost.

Considering first the cost of operation, the expense for power naturally depends upon the efficiency of the plant, cost of fuel, labor, etc., and varies with every plant. This expense may be expressed, however, in terms of the cost of a horsepower and thus apply to all installations. The expenses for labor and supplies are more constant and a fair average value for them is known. For an inclined conveyor more power is required and the consumption of supplies is also somewhat increased.

The cost of maintenance may be divided into 2 distinct charges, one that may be considered as fixed for any particular width of conveyor of ordinary length, or constant for the capacity of the average conveyor, and the other depending upon the length of the conveyor.

The burden may be divided likewise into a fixed charge, depending upon the capacity of the conveyor, and one varying with the length of the conveyor. The net operating cost should then be somewhat different for a conveyor carrying coal and one conveying ash, but as the fixed maintenance and burden charges bearing upon the operating cost are but a small portion of this total cost for even a short conveyor, and as the capacity of similar conveyors carrying coal and ash vary by but about 10 per cent, the net operating cost of handling the 2 materials by belt conveyors may, for all practical purposes, be considered the same. A table in the Practical Reference Tables gives the operating cost of belt conveyors when carrying coal or ash in terms of the cost of a horsepower and another table gives similar data for an installation where the cost of a horsepower is $60 a year, a rate at which any ordinarily efficient plant should be able to furnish power.

TUNGSTEN

FOR many years the mineral tungsten (the name meaning heavy stone) has been known, but only comparatively recently has it become of economic importance. The most important use, according to Frank L. Hess, of the United States Geological Survey, and the one which makes tungsten mining on an extensive scale possible, is as an alloy for tool steel. Lathes using tools made from tungsten steel may be speeded up until the chips leaving the tool are so hot that they turn blue, an operation which would ruin the temper of high-carbon steel. It is stated that about 5 times as much can be done with lathes built for such speed and work as can be done by the same lathes with carbon-steel tools. From 16 to 20 per cent of tungsten is ordinarily used in lathe tools. The melting point of tungsten is exceedingly high—5576 deg. F.

Tungsten also has an important use in making incandescent electric lamps, crucibles for electric furnaces, and various other articles.—U. S. Geological Survey Bulletin.

REASON FOR LOW MECHANICAL EFFICIENCY IN SOME POWER PLANTS*

By John W. Lane

IN beginning, it is to be stated that low engineering efficiency in a plant may be due to conditions which make for business efficiency. This may be because money which would be spent in putting a new plant in first-class condition can be more profitably used in the business, or because the industrial requirements of the plant demand an arrangement and system of operation other than the best engineering practice would indicate.

For instance, in the case of a new office building, usually it is necessary to cut down on estimates of cost from the first plans, and the mechanical equipment is apt to suffer. In order to maintain the 75 per cent full which is considered as renting efficiency, there must be good toilet facilities, good elevator service, and a good heating plant. There must also be attractive finish and good appearance to the building. These things prevent cutting down largely on the architectural features, and the mechanical equipment and power plant are apt to be the losers.

In the case of a manufacturing plant, the works is usually the product of growth and mechanical equipment has been added from time to time as needs demanded. Frequently it is impossible to scrap the old power plant or plants, for money can be better invested in the business, and the delay in shutting down would entail heavy loss.

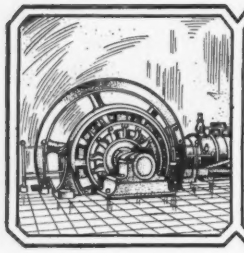
It is, therefore, the business of the chief engineer to do the very best he can with the equipment and working force at his disposal. He must "practice all he knows all the time" to get the best possible economy. In this connection, the time of the chief engineer should be devoted considerably to the methods of burning fuel, for remote control on the coal pile is bad. More money can be saved by living and thinking in the boiler room than by sitting in the office, and the engineer who spends time in the boiler room gets the plant down to the lowest cost.

Bad purchasing of machinery and supplies makes trouble, and difficulty is often encountered in a plant where the purchasing agent buys everything and the engineer must do the best he can with what is given him. As a rule the dollar is all that the purchasing agent can see, and the quality and performance, except as they are forced on his attention by others, do not come into his reckoning.

In the matter of cost of power, the operating engineer's business is the cost at the switchboard or on the engine shaft. The matter of depreciation allowance on plant is not his concern. In regard to this matter of depreciation, there is much difference of opinion, as has been shown by several recent discussions. It is, however, necessary for the chief engineer to have a good idea of accounting and to practice this science, to the end that he may know what his costs are and be able to compare their variation from month to month and the performance of his plant with that of other plants of similar character and size.

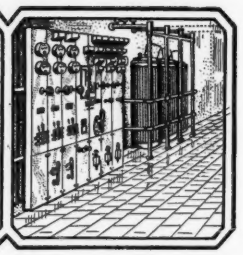
Real success depends upon straight facts, however disagreeable they may be, though good humor is often a winning asset.

*Abstract of an address delivered before Stationary Engineers' Ass'n. No. 1, of Chicago.



Electrical Machinery

For Generating, Transmitting and Using Current



TRANSFORMER TESTING II

By V. E. Johnson

TO test for regulation the simplest way is to measure secondary voltage with the transformer operating under no load—and then again with secondary supplying full load. The latter voltage should not be more than 3 per cent lower than that indicated at no load. If not convenient to connect primaries directly to the high-tension buses, a transformer may be connected reversed to the secondary buses, as shown in Fig. 1, and so supply the primary of transformer under test with the proper voltage. Voltmeter, v, is used to note whether the supply voltage is constant, it is not needed if a voltage regulator is used.

Another method is to connect the transformer under test as shown in Fig. 2, and using banks of lamps

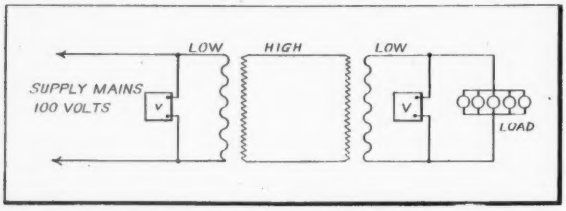


FIG. 1. TRANSFORMER CONNECTED REVERSED FOR TESTING PURPOSES

as series for load, but with a 2300 volt transformer this method is too cumbersome.

Testing Copper Losses

COPPER losses are readily calculated if the resistances of the coils are known. This may be measured with an ordinary Wheatstone bridge, or if one is not available by means of the ordinary drop of potential method, too well known to warrant describing. The copper loss equals in watts the current squared, multiplied by the resistance. This loss, however, can be measured directly by connecting as shown in Fig.

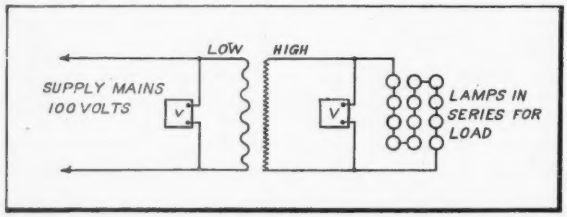


FIG. 2. TESTING REGULATION ON HIGH-TENSION SIDE

3. This method is not exactly accurate, for when R is adjusted so that A carries full load current, W indicates not only the copper loss, but also the iron loss; but under this reduced voltage the latter is so small (2 or 3 watts in a 1500 watt transformer) that it is considered negligible and the wattmeter reading is taken as the copper loss.

Transformer Impedance

OCCASIONALLY one desires to find the impedance of the transformer. For this purpose the connections shown in Fig. 4 are used. The resistance R is adjusted so as to give full load current through ammeter A. The voltmeter V then indicates the impedance voltage, and the impedance equals the voltage divided by the current.

To get the reactance from this, extract the square root of the impedance, subtract the square of the resistance of the coils from this root and extract the square root of the remainder.*

Efficiency

EFFICIENCY calculations are simple and easiest explained by an example. Let us take the case of a 60-cycle, 5-kw., 2000-volt primary and 100-volt secon-

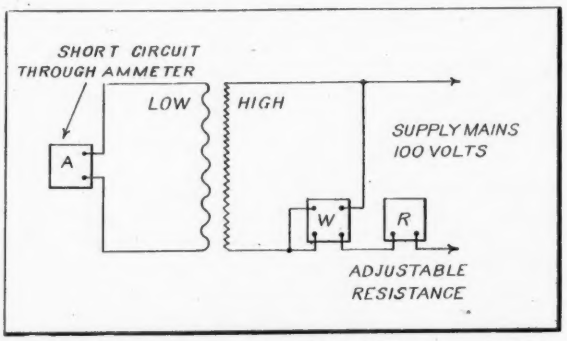


FIG. 3. CONNECTIONS FOR DETERMINING COPPER LOSS

dary transformer. We proceed to tabulate data and calculate as follows:

Resistance of primary coil	10.2 ohms
Resistance of secondary coil	0.042 ohm
FULL LOAD	
Primary current by ammeter	2.5 amp.
Secondary current by ammeter	50.0 amp.
Core loss, total	70 watts
COPPER LOSSES	
Primary ($2.5 \times 2.5 \times 10.2$)	63.75 watts
Secondary ($50 \times 50 \times 0.042$)	105.00 watts
Total loss of full load	168.75 watts
Full load output (50×100)	5000.00 watts

*$I = E \div \sqrt{R^2 + W^2L^2}$
E=voltage indicated by V.
I=current indicated by A.
R=resistance of coils previously calculated.
$\sqrt{R^2 + W^2L^2}$=impedance
WL=reactance.

Total full load intake	5168.75 watts
Full load efficiency (5000 ÷ 5168.75)	96.5 %
HALF LOAD	
Core loss, total,	70 watts
COPPER LOSSES	
Primary (1.25 × 1.25 × 10.2)	15.9 watts
Secondary (25 × 25 × 0.042)	26.2 watts
Total losses	112.1 watts
Total intake (2500 + 112)	2612 watts
Efficiency (2500 ÷ 2612)	95.7%

From the above the "all day" efficiency is readily calculated. The standard assumption is that the transformers operate 5 hr. "full load" and 19 hr. "no load." The all day efficiency equals total output in watt-hours divided by the total input in watt-hours.

The output is:

5 hr. full load, 5×5000 or...25,000 watt-hours
19 hr. no load..... 0 watt-hours

Total output.....25,000 watt-hours

The intake is:

5 hr. full load, 5×5168 or...25,840 watt-hours
19 hr. no load, 19×70..... 1,330 watt-hours

Total intake.....27,170 watt-hours

Efficiency=25,000÷27,170, or 92.2 per cent approximately.

The core loss alone of this transformer was 1680 watt-hours per day, or 613,200 watt-hours a year. If the core loss through aging had increased to 100 watts, the loss a year would be 876,000 watt-hours, or an increase of 262,800 watt-hours.

At 8 cents per kilowatt-hour this represents a loss of $21, to say nothing of the larger equipment at the power house necessary to overcome these losses. Even figuring on the cost of production basis, the total core loss in the one transformer at 1c a kilowatt-hour is $6.13 at normal core loss, or $8.76 at abnormal loss.

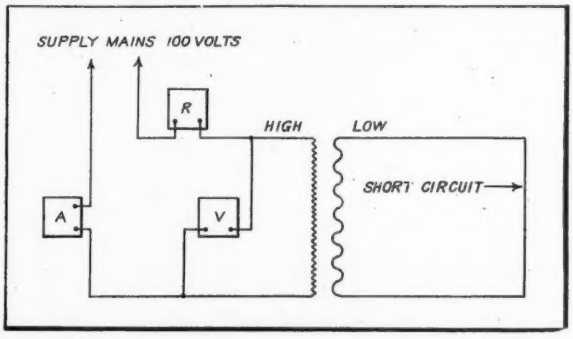


FIG. 4. TRANSFORMER CONNECTIONS FOR DETERMINING IMPEDANCE

Meters for Testing

INSTRUCTIONS regarding meters may not come amiss. Ammeters registering 5 amperes on one scale and 10 amperes on the other, are most convenient. In registering large currents, a current transformer of say 400 to 5 ratio, so arranged that the number of primary turns can be varied at will to give anything up to 400 to 40 or even 400 to 60 ratio should be used. This would be cheaper and safer than using large ammeters directly in circuit.

Voltmeters should have 2 scales—one reading up to 75 volts and the other to 300. This could be used for higher voltages by using a multiplier with say 6000, 12,000, 18,000 and 24,000 ohm resistances. In using these the readings of the voltmeter must be multiplied by the factor of the resistance used in order to give the true volts. For instance, with a certain voltmeter, 6000 ohms in the multiplier gives a factor of 1.579. Then if the meter reads 100 volts, the actual volts would be 157.9 volts.

A convenient wattmeter is one with 5 amperes current capacity and a voltage capacity of 150 to 300 volts having 2 scales. For currents larger than 5 amperes, a current transformer should be connected to the current coil and, if necessary, a multiplier used in series with the potential coils. In this case the readings in watts on the meter would have to be multiplied by the ratio of the transformer and by the factor of the multiplier. Figure 6 shows how an ammeter, wattmeter and voltmeter would be connected to mains using current transformers and multipliers.

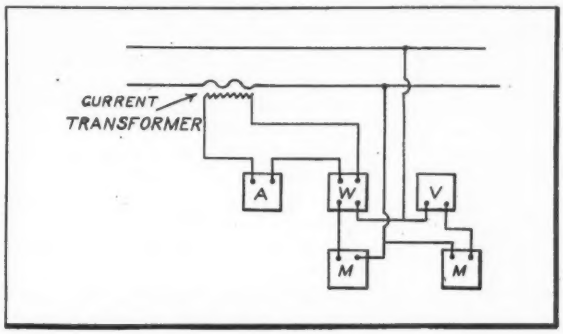


FIG. 5. METHOD OF CONNECTING AMMETER, VOLTMETER AND WATTMETER WITH MULTIPLIERS AND CURRENT TRANSFORMER

A great amount of work can be saved by arranging a table with ammeters and voltmeters permanently connected, or if this is not desirable, with connections so arranged that meters can be instantly connected These tables can be designed in a variety of ways, and no difficulty will be experienced in their making.

I do not believe a power house engineer can find any more interesting and profitable occupation than performing these tests. It ought not to be difficult to convince the superintendent that he ought to buy the necessary apparatus. After that has been accomplished, a carefully kept record will show the condition of each transformer, and "it's up to the old man" to say whether he prefers to lose money on old transformers or go to the expense of replacing them with others. A wide-awake man will not hesitate long.

PUTTING OUT MOTOR FIRE

By R. A. CULTRA

A SHORT distance from our station was a chemical works, the proprietor of which was making a most earnest endeavor to use 3-phase alternating current to perform the work, as it would be clean and so much stronger in operation and it would be far cheaper. After attempting to use the 3-pole distilling apparatus with the usual large size lighting transformers which would continually burn out, the General Electric Co. constructed a rotary transformer to be used in connection with 3 specially built air cooled transformers, air being supplied by a fan driven by an induction motor.

I had noticed on the transmission panel in the station that afternoon that the load had suddenly dropped off at the works, but thought little of it as they fre-

quently did not get time to notify us of the sudden changes which had to be made. Suddenly the private telephone rang with a vengeance and grabbing the receiver I heard a most excited voice state something about the transformer room and still and motor being all alive and on fire, and I must come over at once. Glancing at the panel board and seeing no current on the meters, I threw the breakers and pulled the switch and went over. I found 4 badly scared Frenchmen trying to get some action into their feet as they were so stiff they could hardly move.

"What's the trouble," I ask. "We don't know," said the foreman.

"What have you been doing? What's all this water you have here on the motor and belt and the floor?"

"It get hot, we cool it off, put pail water on and whee, belt come off, my hands jump at the pail, the pail jump at the motor, my feet oop-la jump at the floor and me no know what hit me. I put on the belt, put in fuse and when I go to put in switch my hand jump at the switch and my feet at the floor, and the fuse it swisch-bang—blow out and I can't make motor run. All 4 men stiff in feet and can't move."

I don't believe any money could have induced one of those men to touch any switch or piece of electric wire or machine again until I put my hand on the induction motor. I conceived the idea that something got hot around the motor and, it being a very warm day, together with the friction of the sticking box, had caused the armature and field coils to get very warm and what oil was left in the box was smoking when it was discovered. The attendant, putting his hand on the top of the frame, found it hot, rushed for a pail of water and luckily had a wooden pail. The foreman followed suit with a galvanized iron pail, the third man came in in time to get his feet into the water on the grounded apparatus. All stood on a form of solenoid connected with the earth but only partially charged through the water.

The fourth man attempting to pull the switch saw the open fuse blow out which nearly blinded him. But he had been in the place some time and knew what to do but did not know why. He at once cut down the transformer current enough to allow the main switch to be pulled with out arcing, which cut off the ground circuit between the still and the transformer room, which was not really necessary but relieved the 4 men who did not dare to move for fear they would get another shock or get killed.

They had then put in the main switch and disconnected the still in order to get current to start the motor, but the man forgot his wet feet and hands and in doing so was nearly knocked senseless. The fifth man came in at this time seeing the man at the main switch get knocked over lost no time in telephoning for assistance and all were relieved by my throwing the breakers on the panel board.

I explained to them how the electric current liked to make short cuts when going fishing by crawling through the little brooks of water that they poured over the armature coils and sometimes burned the coils as it did so. They got wise and no more water was ever used in the transformer room.

There were 2200 volts on the transformers at the time the belt came off, and the motor and belt had thrown water all over them. The only reason I can see why the men were not cremated and the apparatus with them is that the entire equipment was new and well insulated. The still current being 65 volts and 1000 amperes could not do any great damage.

DISTRIBUTION OF LUMINOSITY IN NATURE*

By Herbert E. Ives and M. Luckiesh

THERE is little dispute that in natural daylight illumination, out of doors, one finds some of the most pleasing distributions of light. There can also be no question that the human eye has by adaptation become most accustomed to these distributions, and finds in them its most healthful activity. It is still, however, an open question whether under the practice of continuing human activities into the night the same character of illumination conditions as in daylight are best. Or ought artificial light indeed be markedly different in composition and distribution from natural light? Only experience and refined physiological methods of testing can settle this question.

A complete analysis of daylight illumination would, of course, be very elaborate. The present study is confined to the distribution of surface brightness in certain cases of out-of-door illumination.

It was thought proper to study surface brightness rather than intensity of illumination because the various surfaces out of doors are of different reflecting power from those of interiors. A close reproduction of the direction, intensity and diffusion of daylight would not necessarily give a similar result in a room, while a distribution of surface brightness could be copied by proper choice of wall coverings and furniture.

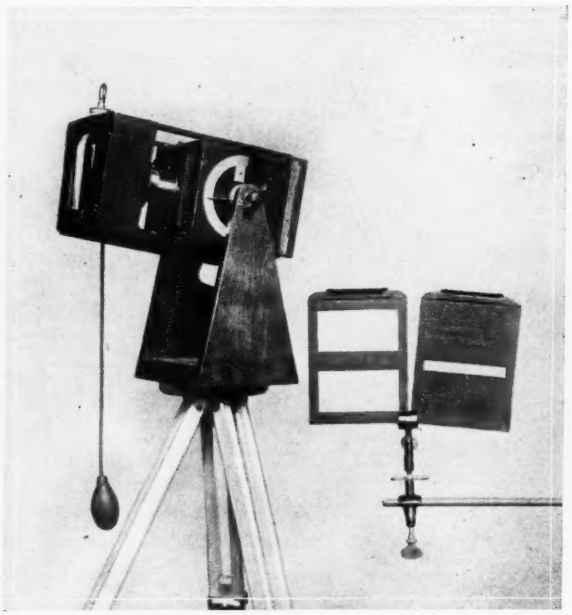


FIG. 1. ARRANGEMENT OF BOX CAMERA FOR PHOTOGRAPHING VERTICAL DISTRIBUTION OF BRIGHTNESS

Briefly, the method was as follows: A box camera, as shown in the illustration, was arranged on a tripod, swung between supports allowing a range of views in the vertical plane from 70 deg. below the horizon to 50 deg. above. In order to give the photographic plate the same sensitiveness to daylight as possessed by the eye, an experimentally found screen of several colors

*Abstract of a paper read at the fifth annual convention of the Illuminating Engineering Society, Chicago.

was placed before the lens, supported in a framework arranged for the purpose.

For obtaining the average light in each view photographed, a bottle filled with chloral hydrate in glycerine acted as a cylindrical lens, throwing everything badly out of focus horizontally, leaving the vertical definition practically unaffected.

The brightness in the different angles as plotted in the charts, is only relative value, determined from an arbitrary standard.

On each plate 2 exposures were made, one without the averaging device; the other with it. The two exposures were kept separate by the use of 2 special diaphragms in front of the plate, shown to the right in Fig. 1, one with a narrow slot for the bottle exposure, one with the complementary opening for the unaveraged picture. The opaque portion of the latter diaphragm is made extra wide so as to leave an unexposed space against which the densities of the averaged strip may be measured. The mode of action will be readily comprehended after examination of the photographs so made.

Studying for a moment one of the figures, it is seen that the numbers indicate the angularity in which each picture was taken. The right half of the center strip indicates the average light of each picture as obtained by the averaging device.

By referring the average light in the different angles to an arbitrary standard, it was possible to plot the corresponding charts, graphically showing the distribution of light. The numbers on the semi-circumference, of course, refer to the angularity. The line O-O° represents the horizon.

Results

FROM a large number of typical scenes taken by the authors, but 3 are here shown. In the search for these views a great deal was learned—almost more than from the pictures themselves. The most striking fact—impressed upon the authors after many miles of tramping in parks and suburbs—is that nature is far from uniformly pleasant to gaze upon. In fact it has been borne in upon us that the chief difference between good and bad in a landscape consists in one thing, namely, the presence or absence of long shadows. The same scene, observed at midday with the sun overhead and then pronounced glaring and ugly, will in early morning or late afternoon be bearable or even charming.

Similarly on overcast days, without the directed shadows of sunlight, an attractive landscape becomes dull and characterless. Compared to the sky as a standard the average brightness of the foreground is at one extreme with midday sun, and the other with the overcast sky. Neither pleases, and from the authors' observations, as illustrated in the figures which follow, it seems improbable that a mere mean of the 2 conditions would introduce the attractive characteristics given by the variety of light and shade under oblique sunlight.

This observation has an immediate bearing on artificial illumination, for in nearly every case our arti-

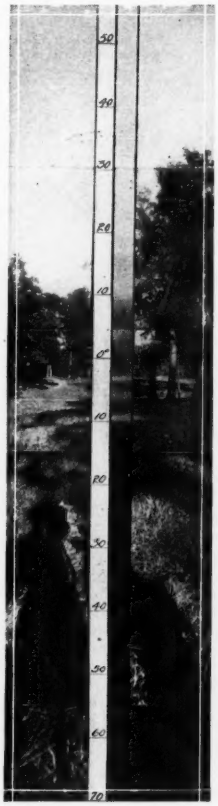


FIG. 2. NEAR ROCKY RIVER, LATE AFTERNOON OF CLOUDY DAY

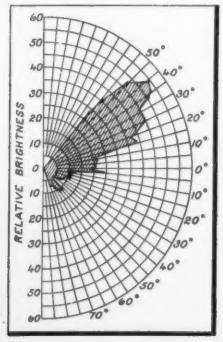


FIG. 2A. VERTICAL DISTRIBUTION OF LIGHT IN 2

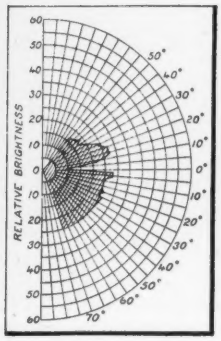


FIG. 3A. VERTICAL DISTRIBUTION OF LIGHT IN 3

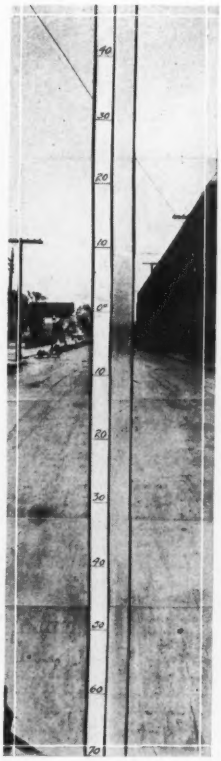


FIG. 3. UNSHADED STREET AT FULL NOON

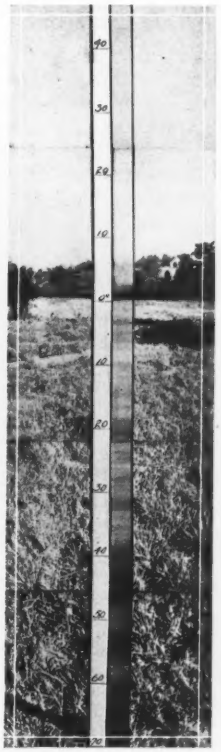


FIG. 4. GRASS FOREGROUND WITH SUN BEHIND THE CAMERA

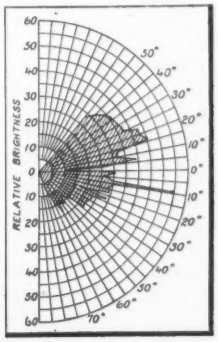


FIG. 4A. VERTICAL DISTRIBUTION FROM 4

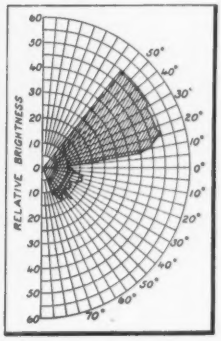


FIG. 4B. VERTICAL DISTRIBUTION AT SCENE 4 WITH SKY ENTIRELY OVERCAST

ficial light, whether direct or indirect, comes from overhead, the very condition under which nature is least pleasing. Lighting by table lamps or wall brackets—in either case out of the observer's line of vision—would therefore appear to conform more nearly to pleasant natural conditions.

Figure 2 is a view at Rocky River, near Cleveland. The time is late afternoon. The sky is dull and cloudy. The sun shines clearly through the trees to the right. The camera is in the midst of the trees. Figure 2a shows the vertical distribution of brightness. The most conspicuous feature is the much greater brightness of the sky than of the foreground.

Figure 3 is a view taken on an unshaded paved street in full noon sunlight on a clear day, with blue sky. This photograph was taken to illustrate the condition of intense glare from the pavement. Here the flux of light below the horizontal is greater by several times than that above and the brightest part of the field of view is the foreground.

In Fig. 4 high grass and dead leaves form the foreground. The sky is clear blue with a few light clouds. Behind the camera the afternoon sun illumines the scene. The brightest spot is a little below the center of the picture. The 2 darkest in the shadows of the grass near the camera and in the trees near the center of the view. The sky presents the portion of most uniform brightness, while the total flux of light above the horizontal is somewhat more than that below. Figure 4b shows the distribution of brightness for the same scene on an entirely overcast day. The difference is most noticeable. From being only a little brighter as a whole than the foreground, the sky is now about 4 times as bright and much more of the total flux of light entering the eye comes from it than before. This, together with the shadowless condition mentioned above, makes the view on the overcast day unpleasant.

Generalizations from so few cases are difficult; many are not warranted. A few facts, however, seem to show clearly. One is that the eye will tolerate a greater brightness and flux of light above the horizontal than below. Thus the pleasant cases, Figs. 2 and 4, show this peculiarity, while the street view with glaring conditions shows the greater flux of light and the brightest spots below the horizontal. On the other hand the case of the overcast sky shows that the eye will not tolerate too great a flux above the horizontal. The fact of the matter seems to be that the unpleasant feature of each case is the presence of large areas of nearly uniform high brightness. The eye can tolerate such a condition in the case of the sky, as shown by Figs. 2 and 4, but it cannot tolerate uniform high brightness in the foreground. In the case of the overcast sky, Fig. 4b, the extended bright area of the sky does not appear to be pleasant, in apparent contradiction to the statement just made. The explanation seems to lie in the fact that in the sky, Fig. 2, there is considerable variety of light and dark due to foliage and clouds. In fact, as noted in the discussion of long shadows, the difference between pleasant and unpleasant conditions seems to lie chiefly in the presence or absence of variety.

Lumeter measurements were made during the course of the work in order to give some idea of the absolute values of the surface brightness and some of the ratios in question. Blue sky measured 2.2 candle power per sq. in. A cumulus cloud in the same sky 10.4 candle power per sq. in. On an overcast rainy day the sky had a brightness of 3.3 candle power per sq. in.; on a darker overcast day the brightness fell to 1 candle power per sq. in. A cement pavement in sunlight had an intrinsic brightness of 6 candle power per sq. in. A sunlit surface and the same surface in shadow show the relation between the direct and diffuse illumination to be about as 3 to 1. The ratio between the brightest and darkest point of the averaged vertical distribution in the most varied landscape is about 20 to 1. The brightest object measured was a white cloud which had about half the intrinsic brightness of a Welsbach mantle.

NEW POWER AND LIGHTING TRANSFORMERS

ACCOMPANYING this article will be noted some views of a new line of power and lighting transformers which are built for single phase circuits, and are of the pole type construction. The normal frequency is 60 cycles, but the frequency limits are from 50 to 140 cycles. Standard voltages are 1100-2200 for the primary, and 110-220 for the secondary.

These transformers are of the shell type construction, and possess many important characteristics of

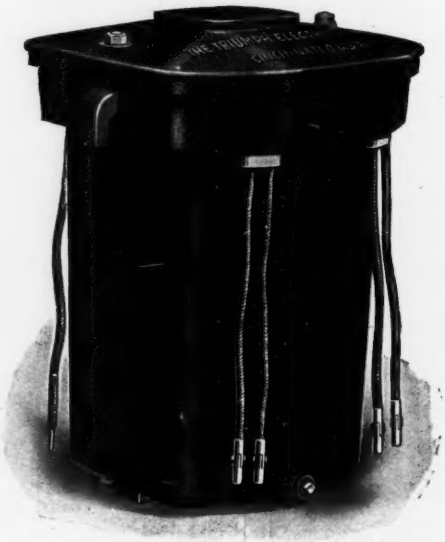


FIG. I. TRIUMPH TYPE L TRANSFORMER

especial interest to engineers. Aside from mechanical construction and durability, transformer losses are the most important consideration in the selection of any particular design. Too often low core loss values are obtained at the expense of other important characteristics. It is a well-known fact that a disproportionately low core loss will produce excessive copper loss and poor regulation.

Similarly, unnecessary insulation is directly responsible for high reactance, poor regulation and a tendency to overheating, the efficiencies being correspondingly low. While core losses are continuous and should be eliminated as far as possible, it is manifestly an error to sacrifice regulation and increase the copper loss in order to obtain unduly low core loss. This is particularly true in regard to regulation. A poorly regulating transformer will cause variation of potential at the lamps, giving rise to flickering and a marked tendency to decrease the life of the lamps.

Triumph type L transformers are designed with these conditions in mind, thus giving excellent reg-

ulation, low copper and core loss values on account of the superior quality and high permeability of the silicon alloy steel used. This steel, it is claimed, is non-ageing even at temperatures well beyond the safe working limit of the transformer.

The Triumph Company of Cincinnati, who is the manufacturer, bases its core loss claims on a sine wave, as recommended by the A. I. E. E., and these are therefore fixed by a well defined standard.

Type L transformer coils are dried under vacuum, and impregnated with a special insulating compound

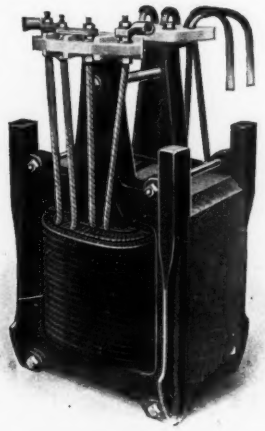


FIG. 2. COMPLETE TRANSFORMER WITHOUT CASE

non-soluble in oil and possessing a high melting point. By the means employed, the impregnating material is forced to fill all crevices to the center of the coil, which assures that the coil has uniform insulating strength.

Transformer tanks or casings are of gray cast-iron. Those up to 10 kv. a. capacity are smooth, while

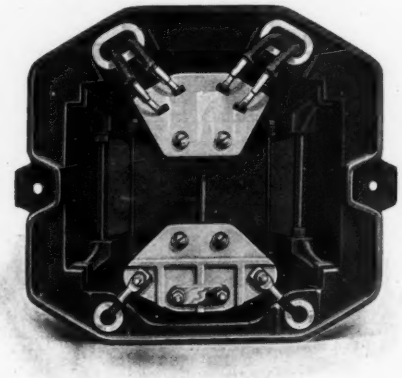


FIG. 3. INTERIOR VIEW OF ASSEMBLED TRANSFORMER

above that size are corrugated to provide greater radiating surface. A moisture-proof joint between the cover and case is secured by the use of a felt gasket cemented into a groove in the cover which is fastened to the case by 2 bolts which compress the felt, making it moisture-proof.

Porcelain bushings are babbitted into the case and after the leads are brought out through them the openings are sealed with an insulating oil-proof compound. The terminal blocks are of porcelain, there being two of these, one for high tension and one for low tension, of different design there is no liability of confusion between leads. The blocks are ordinarily placed above the oil level for convenience in changing connections.

In general design, the transformer is comparatively light in weight, being intended for mounting on poles and the various sizes are provided with suitable hooks and lugs to aid in handling them.

A LIVING STATUE

CHARLES J. MASON

WITH 8 tandem compound engines in a row and the only visible means of escape a horizontal dive through a number of running belts, how differently men will act when suddenly surrounded by a shower of lightning, and then left in total darkness was illustrated recently in a railway power plant.

Engineers with ideas toward efficient belt operation laid out this plant, for the engines and generators which they ran were as far apart as the building walls would permit, scarcely room enough along the sides of the room remained to let the engineer's apprentice slide through, to say nothing about a full grown man who has been on the road several years and has the best when he would dine.

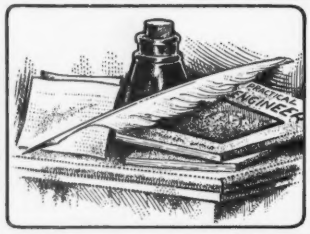
Space in a vertical direction was also at a premium for the engine belt wheel had to run nearly half way down into the basement in order to keep from bumping its head against the ceiling. This, however, proved quite convenient for it permitted part of the belt to run under the floor, and left a passageway the entire length of the room where a man, exercising care, could walk between the running belts with entire safety.

At the crucial moment there was a party of 3 belt makers repairing one of the belts; they were in the act of cementing the joint and all were working away happily without any concern for what was going on about them. Being the time of peak load, 7 p. m., the engines were slightly overloaded, and it was dark at that hour. Without warning of any kind, the machine next to where the men were at work on the belt began to throw out a shower of sparks accompanied by cannon like reports. For a few moments the whole station was intensely illuminated, and then just as suddenly all lights went out, leaving the place in total darkness.

The engineers and oilers went scurrying around trying to find the cause of the trouble, and for a short time nothing was heard but the pattering of their feet upon the engine room floor.

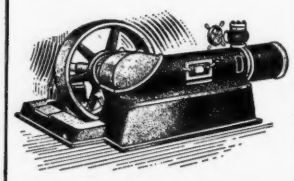
Upon the first indication of trouble the belt men, who were kneeling upon the belt, decided they were in a precarious position, but there was some difference of opinion in regard to which way to go, so two of them jumped to the floor and made their escape to safety through the belts, one receiving a badly sprained ankle as a result of his decision. The third concluded rapidly to take the decision to higher court, and ran up the belt until he stood at the top of the engine wheel where he remained, 15 ft. above the floor, surveying the rapidly changing conditions until the station lights could be turned on again, which to the other men in the plant was like the unveiling of a monument to the inventor of a steam engine, for the belt expert stood as rigidly poised and white as a marble statue from which attitude he was aroused only after roars of laughter administered to him by his fellow workmen.

The belt men did no soldiering on the job after this experience and considered themselves fortunate that none of them was a petrified monument to industry.



Letters from Engineers

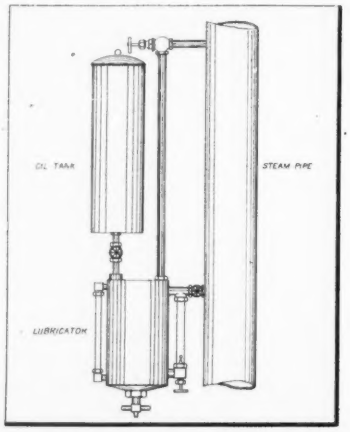
Bright Ideas direct from the plant. Send us yours. Cash paid for those accepted. Sketches desirable; we make the drawings



HANDY LUBRICATOR DEVICE

FOR those who have not been able to persuade the man higher up that a force feed oil pump is the proper lubricator to have, the little device illustrated will save much time and oil. I would, however, recommend the force feed oil pump if possible to get it for the following reasons: The feed is positive regardless of temperature changes. Being driven by the engine which it is lubricating, it necessarily stops and starts when the engine does, thereby eliminating waste of oil through forgetting to stop it, as is often done with the hydrostatic lubricator. There are no gage glasses under pressure to burst and throw oil over the bright work. There is also one very good point about oil pumps, they all have a place large enough to pour oil into, while the majority of hydrostatic lubricators have a filling hole that is too small, and in filling, the most careful engineer is liable to spill oil.

For the lubricator with a small hole this little device is especially recommended. I made this one out



LUBRICATOR WITH FILLING TANK

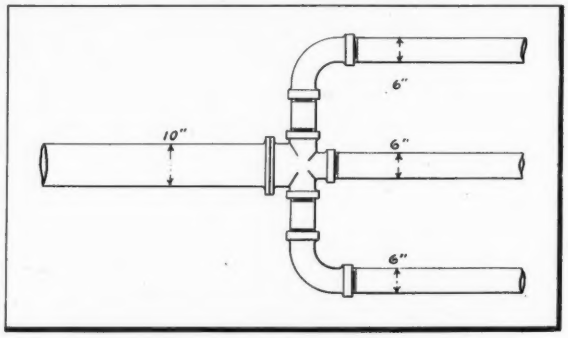
of a piece of sheet brass, which was used for the oil reservoir, a coupling, a globe valve (preferably a metal disk) and 2 short nipples of ⅜-in. brass pipe. The only difficulty encountered in the making of this is that, as a general rule, the filling plug is not tapped a standard pipe size. I overcame this by reaming the hole out with a 19/32-in. reamer and then tapping out with a ⅜-in. pipe tap.

The operation is simple; shut off the lubricator in the usual way, then open the drain valve between the oil tank and lubricator, when the water will drain out and its place will be taken by the oil. The fact that gravity acts on the oil greatly hurries the operation of filling. The drain valve is watched closely and the instant oil appears it is shut off, the valve between the lubricator and tank is closed, steam turned on, and the feed adjusted.

I would advise caution in one thing, however; do not forget and open the steam valve before closing the filler valve. If this is done there will be a deluge of red hot oil and to all probability a few well chosen words of a violet color. Oscar J. Richmond.

SUCTION PIPES TOO SMALL

IN looking over the plan of E. T.'s pumping plant I am quite convinced that the trouble is in the suction intake from the lake. I see there are 3 5-in. pipes which are not large enough for the header, which is a 10-in. with an area of 78.54 sq. in. If these were changed to 3 6-in. pipes it would give you the area of



SUCTION PIPE ARRANGEMENT

84.75 sq. in., which would be about right with the friction on them. The accompanying plan shows how it will look when changed. K. R. Smith.

CAN ENGINE RUN AWAY

ARE there any conditions under which an engine with a shaft governor could run away, was a question asked in an examination. Many of them have. That ought to settle it. About 2 yr. ago there was a serious flywheel explosion at Scranton. The engine was equipped with a shaft governor. But knowing that such an engine can run away is only half an answer after all. Unless we know what will cause such trouble, we are not very well prepared for the emergency. We must know what to guard against.

A governor that has not been oiled or that has been improperly cared for may stick. As long as the load and steam pressure hold constant, all will be well If the load increases, well and good, you are warned of trouble by the slowing down of the engine; but if the load drops off, away she goes and it is up to you to do some quick work.

The weight arms of some shaft governors are hollowed out to receive disks in case it is desired to change the speed. These disks are bolted on securely; but should they ever get loose and drop out, the engine will speed up. The dashpot, through inattention, may get stuck and a race ensue.

Screw down tightly on the valve stem packing, and if the engine has shaft governor, it will speed up—

possibly run away. To understand why, we must go back a moment to "first principles." Let us start up an engine with shaft governor. As it reaches speed, the weights fly out and advance the eccentric, giving earlier cutoff. The pull of the weights is balanced by the springs. If the weights advance the eccentric too far and cause too early cutoff the speed falls, the weights lose centrifugal force and the springs pull them back and the eccentric with them. It is a very delicate balance. Consider now what you do when you tighten the packing on the valve stem. This makes it harder for the eccentric to drive the rod and valve, and this extra load is transmitted back to the weights. It now takes more centrifugal force to make those weights fly out and advance the eccentric. If you should tighten up on the springs, the engine would run faster. Everyone knows that. And it runs faster because it must increase the centrifugal force of the weights by an amount equal to the increased pull of the springs. In tightening up on the packing you have done something very similar. Hard, dry packing will cause the same trouble.

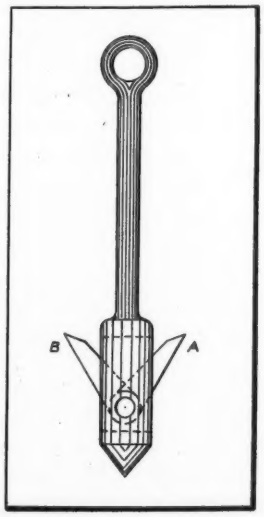
If the lubricator runs dry, or if you forget to open it, and the valve gets dry, the same state of affairs is brought about.

These are some of the causes that will operate to start an engine on a rampage. There are others. Look for them—and look out for them.

William E. Dixon.

REMOVING DEEP WELL PIPE

AFTER reading the article by Mr. Eckley in the September issue of Practical Engineer regarding the removal of the pipe from a well I thought the methods employed in a similar case might be interesting reading. In the case which came under my observation the well was 8 in. in diameter and 350 ft. deep.



HOOK USED TO CATCH PIPE

The well was driven by the usual methods, a pipe being driven down to bed rock, in this case 120 ft., and the rock forming the well casing for the remainder of the distance. Water in this well stood at 25 ft. from the surface and was to be raised to a tank on the roof of a 4-story building.

The air lift system was to be used and the 2 pipes, one 1¼-in. pipe for air and a 3½-in. for water delivery, were to be sunk to within 3 or 4 ft. of the bottom, so they were made and clamped together and lowered into the well a length at a time. When 150 ft. had been made up and lowered, the lowering tackle suddenly parted and the pipe disappeared from view and stopped only when its lower end rested on the bottom with the top 200 ft. from the surface. Getting the pipe out was a necessity, but how to go about it was a problem.

It was finally decided to make a spear like the sketch shows and small enough to slip inside the 3½-in. pipe, the ears A and B, swinging on the pivot and closing up when dropped inside the pipe, but opening out and catching when any pull was exerted in an upward direction. It was hoped that this would catch in the joint where 2 lengths were joined by a coupling as the 2 ends would not quite butt together, thus making a short space equal in diameter to the inside diameter of the coupling.

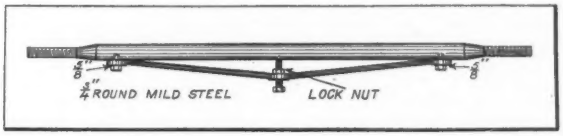
The spear was lowered and raised by means of a heavy rope and after fishing about 2 days we got a bite on the pipe and after raising it a few feet the upper end caught an obstruction and the rope broke, leaving the spear and several feet of rope in the well. A new one was secured and operations started again with the same result.

After about a month's work along these lines a contractor took the job to get the pipe out and proceeded along the same lines, but with more care. A hand winch was put in place and a wire cable used instead of a rope. After 2 days, careful work part of the pipe was removed it having broken in two in the repeated falls; 2 days more were taken in securing the remaining lengths; all of the broken tackle came with the spears which did their work well, as they were found securely stuck in the joints.

C. B. Hudson.

STAY FOR ECCENTRIC AND REACH RODS

ENGINEERS who have trouble with vibrating eccentric and reach rods on high-speed Corliss engines may be aided by placing a stay on them. It is a well tried method and has given perfect satisfac-



STAY FOR ECCENTRIC AND REACH RODS

tion after 5 years of use. The method of construction can be seen from the sketch. Richard Howarth.

WHY A DEEP WELL PUMP LOST ITS WATER

A DEEP well pump whose plunger reached 180 ft. into the ground, and worked in a 6-in. bore, was used to supply cooling water for an absorption system refrigerating plant. For 3 or 4 yr. this pump gave perfect satisfaction, but finally began to acquire a bad habit of losing its water at most unexpected times; that is to say, it would run very nicely for 3 or 4 and sometimes 5 to 7 hr. and then suddenly, for no apparent reason, would fail to raise any water.

At first it was thought that the water was low in the well, but this theory was thrown out by the fact that at times the pump would pick the water up again and keep it for the remaining part of the run.

The operators speculated as to the cause of the trouble and by the time the chief ordered the plunger

raised it was generally decided that the leather packing was worn out; consequently they were somewhat surprised to find it in first class condition. The foot valve was examined, but this also proved to be in good condition, but still when the pump was run again it continued to lose its water as before.

A pump expert was then called in, who brought a crew of men with a hoisting engine and removed the 6-in. casing. This, however, proved to be perfectly tight, and although he charged a substantial price for his work, the expert failed to improve matters.

Then the chief decided that at times the pump was pulling sand with the water, which was keeping the foot valve from seating; so he had a cage made of brass to fit the casing and, after covering it with a very fine brass wire screen, fastened it below the foot valve.

The pump has run for 3 yr. since and no more trouble has been experienced from lack of water.

J. F. T.

THE HOLLY STEAM LOOP

IN a recent issue, J. C. Hawkins gave a very interesting description of the Holly steam loop, but he confuses somewhat on the principles underlying its operation. He says his discharge chamber is 35 ft. above the water line of his boilers, and then continues: "The object of placing the discharge chamber at this height is to overcome any siphoning action in the drain line or receiver." In the plant where I am employed, the bottom of the discharge chamber is

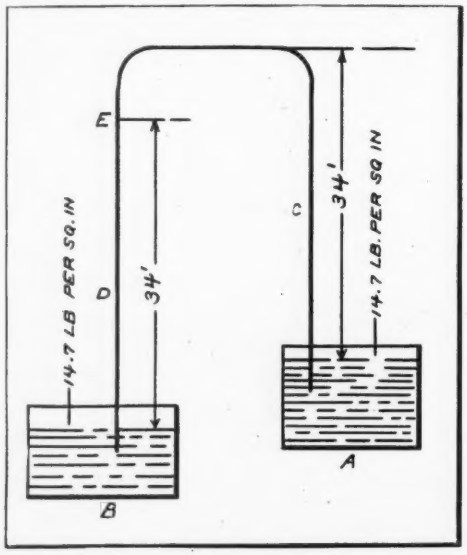


FIG. 1. SIPHONING BETWEEN TWO TANKS

only 19 ft. above third gage, and we have never had any difficulty from siphoning. Nor have we looked for any. Just what led Mr. Hawkins to make that statement is not plain; but it may be because he has learned that water will siphon 34 ft. Theoretically it will do so if there is no friction, but friction is always present; leaving that aside for the moment, why is it that water will siphon 34 ft.?

In Fig. 1 we have 2 tanks of water, the level in tank A being somewhat above that in tank B, and connecting them is a pipe loop extending 34 ft. above the water level in A. Let this entire loop be filled with water, then what will happen? Atmospheric pressure will support a column of water 14.7 ÷ 0.433 = 33.9 ft. high. The column of water in C will, therefore, be entirely supported; but in D the water will tend to drop to E, 34 ft. above the level in B. This tends to produce a vacuum above E, and this is filled from the horizontal part of the loop, and this in turn will be kept full, because atmospheric pressure on the water in A will force water to that height. This will continue until the level A falls perceptibly; then the siphoning action will stop.

This is the action of the siphon. If the water in the tanks and pipe is very hot, no vacuum will be formed above E; but steam will fill the space and there will be no siphoning action. Hot water will not siphon. If it would we shouldn't have to be so careful in setting receiver pumps, and feed pumps taking water from open heaters.

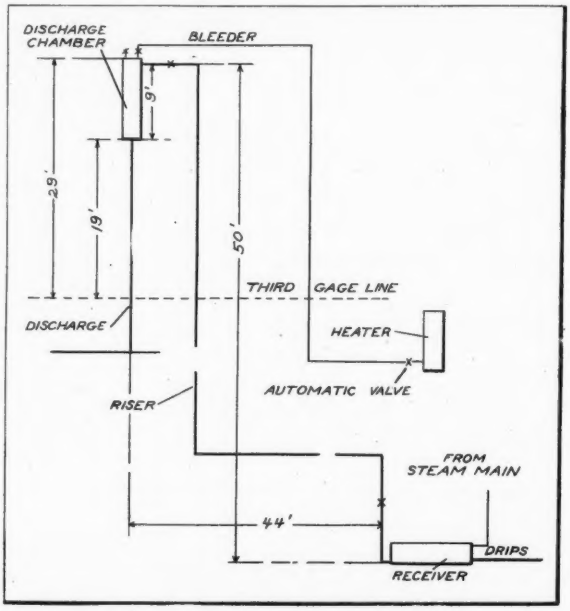


FIG. 2. DIAGRAM OF A HOLLY SYSTEM

Two conditions for the siphoning of water 34 ft. are then: cold water and pressure of 14.7 lb. per sq. in. In the Holly system we have hot water and boiler pressure, whatever that may be, but surely several times 14.7. So there is no possible parallel between the 2 cases.

Figure 2 is a diagram of an installation with which I am familiar. Boiler pressure is 150 lb. and this is maintained in the receiver by the pressure pipe taken directly from steam mains. Let us assume that the bleeder on discharge chamber reduces the pressure at that point to 140 lb. Then the 10 lb. excess pressure in receiver would support a solid column of water in the riser about 20 ft. high; but the riser is filled not with a solid column of water but with slugs of water and steam, or perhaps a spray, and this the 10 lb. excess pressure drives up into the discharge chamber. Here the water separates from the steam, water falling to the bottom of the chamber and steam passing out through bleeder.

We have a pressure in the boiler of 150 lb. and a pressure in the discharge chamber of 140. This 10 lb. excess pressure in the boiler will support a column of water in the discharge pipe about 20 ft. high. But as soon as the discharge chamber fills above that point, the weight of the column of water plus the 140 lb. pressure in the discharge chamber is greater than the

150 lb. pressure in boiler. The check opens and water drops to the 20 ft. level in discharge chamber. This is the action of the Holly system.

Specific pressures have been assumed for sake of brevity in explanation. Each one may change the figures to suit his case. But this is the general proposition: that it is necessary to reduce the pressure in the discharge chamber enough so that the mixture of steam and water will be lifted by the excess pressure at the receiver. And the distance from water level in boiler to that in discharge chamber must be enough so that the head of the column of water will exceed the difference in pressure between boiler and discharge chamber.

Mr. Hawkins' description of method of starting and operation is fine. We have, however, in our installation something which he seems not to possess. He has to throttle his bleeder valve to get the required pressure in the discharge chamber. Instead of that we have a special valve that does the work automatically. It is made like a globe check, except that it is loaded with a spring which can be set with key, so that any desired back pressure may be maintained.

Mr. Hawkins lays much stress on the fact that there are no sharp turns in his riser. Of course this is a good feature anywhere; but let no one be discouraged if he cannot design his system so carefully. In our installation there are 7 90-deg. and 3 45-deg. ells in the riser; but we have never had the least bit of trouble. In fact, the system seems ideal for returning high pressure condensation. William E. Dixon.

BLEEDING A BOILER

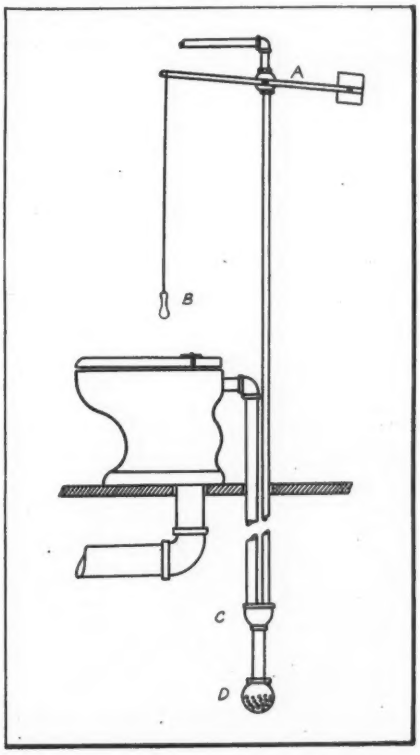
'TIS true that "the ways of Providence passeth all understanding," for if it had not been for its kind intervention my wandering footsteps might never have been led to a certain gentleman who travels the rocky road of life under the burden of the ancient and illustrious cognomen of Simms. Now Simms, before taking up his present condition of servitude as sawmill foreman, was "scoop artist" for a brief period on an asthmatic old switch engine that once did duty years ago on "the elevated." But that's another story, and I return to the case in hand.

By virtue of the foregoing, Simms imagined himself an authority on engineering, both locomotive and stationary. On a certain occasion he was visiting a neighboring mill, in which the engine was a Corliss, a little small for the work and which at times of heavy overloads "hung up" and took steam for full stroke. At such times a considerable amount of water was thrown from the exhaust, as the engine exhausted into an open heater and when an overload came on suddenly quite a quantity of water was coughed out at the exhaust pipe. Such was the case on the day of Mr. Simms' visit.

He was standing near the engine room when suddenly several gallons of water shot from the exhaust and fell to the roof with a splash. Simms gazed at the dripping roof with astonishment and in a few minutes the occurence was repeated, whereat the valiant Simms buttonholed the fireman and inquired as to the cause of the phenomenon, but the fireman being of Yankee descent, answered the question by asking another, "What's your idea of it, Mr. Simms?" "Why, I suppose it is drawn over from the boilers," replied Simms. "You've said it," returned the fireman, trying hard not to laugh. "Well," commented our hero, "you must have one sweet time keeping water in those boilers." Eddy Current.

HINTS ON PLUMBING AND METER READING

IN a certain plant where peculiar conditions existed, it was found impractical to dispose of sewerage by the usual methods, so the following scheme was devised and proved very successful. The buildings were located on the banks of a lake, the water of which was used for supplying a nearby town, making it inadvisable to allow the sewer pipe to discharge directly into the water. Before using the water for city purposes all closet drains had emptied directly into the lake, so that it was a simple matter to obtain flush water simply by raising it 8 ft. A steam line was carried to each toilet and an ejector or suction tee was placed near the surface of the water, into a foot or check valve, D, on the suction line to make the flushing action instantaneous. The valve A, in the steam line is



AN EJECTOR USED FOR FLUSHING

a ½-in. chronometer valve with extended lever and counterweight. By pulling cord B, as in an ordinary closed tank, steam is admitted to the water lifter C, which draws and forces the water into the closet bowl, thereby effecting flushing, etc. By the direct contact of steam and water the latter is heated and cleanses the fouling surfaces more readily than cold water. An arrangement of this sort, or one whereby hot water is used, is far more sanitary, especially in factory closets, where, unless great care is exercised, the bowls are often fouled.

Furthermore, a small quantity of steam is required for a fairly large quantity of water. Coupled with the low cost of operation is the small first cost. The valves and ejector can be obtained for between $3 and $10, the cost depending upon the types selected. A quick opening gate valve may be substituted for the chronometer valve and where the water lift is small a suction tee may be used. These can be furnished at the lower price, while a sensitively balanced chronometer

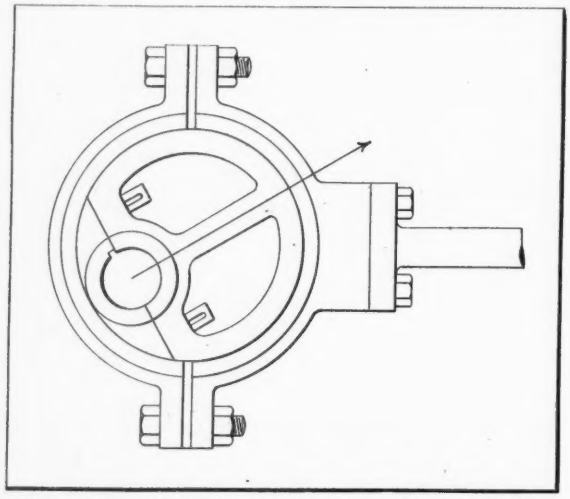
valve and an all brass ejector will cost the latter amount.

It is almost needless to state that the foot valve should be the best obtainable, in order that the suction pipe may always be full of water, so that as soon as steam is turned on the water lifter will begin to draw immediately. Failing to start with a perfect suction, it would be possible for the steam to short circuit and possibly scald somebody. Although this device has been in use several years no such trouble has been experienced as care is taken regularly to examine and renew, if necessary, the foot valve seat.

In reading water or gas meters in damp places an engineer often finds that considerable condensation collects on the inside of the recording dial glass and so fogging it that it is impossible to read the meter. As a candle is usually carried, for meters are more frequently placed in out-of-the-way dark corners, it will be found that, by dropping the hot melted wax on the glass and allowing it to remain a few minutes, the water underneath is entirely evaporated and dial is clearly seen. W. Simpson.

FLAT ECCENTRICS

AFTER many years of experience around railroad shops, I have come to the belief that eccentrics, at least on locomotive, always wear flat, and further that the point of most wear is always the part of the block nearest the shaft. There are, I think, 2 good reasons for this. The first is one I read in the Railway and



DIRECTION CENTRIFUGAL FORCE ACTS ON ECCENTRIC

Locomotive Engineer some months ago and the second is one of my own, or at least I have never heard any one else give it.

First; centrifugal force. No matter what the position of the eccentric strap, this force will act upon the short side of the block, causing it to wear fastest. Second; the strain of stopping the valve and other parts of the gear at the end of the stroke and also of starting them back in the other direction, both fall on this part so in a high-speed engine, at any rate, this part of the block does almost all the work.

John A. Cook.

WHAT MADE THE NOISE?

WE HAVE a 1200 16 candle-power d. c. dynamo, direct connected to an engine making 250 r. p. m. The bearing upon which the flywheel governor operates to control the eccentric is 10½ in. long, and has 3 holes in the body of the shell, through which to apply lubricants. The 2 end holes having been plugged with wood in the erecting shop, and painted over with the rest of the work, and a compression grease cup attached to the center hole. The ordinary yellow lubricating grease was used to lubricate this bearing, and it has always been necessary occasionally to mix a little engine oil in the grease, as the latter apparently becomes dry, and causes the governor to work badly. For a space of 2 or 3 weeks after the grease that had been thinned with oil was applied the regulation was very good.

Recently a sample can of automobile grease was delivered for trial in various places, and the above bearing got mixed up in the lot, and for a time the results were very satisfactory, and the automobile lubricant was voted a high degree friction reducer, but it did not last long. As soon as the high degree grease had cleaned out all of the old dry grease, it found a way to work out at one end of the bearing, and left the opposite end dry, and then the real trouble began. The governor would work so badly that the voltage varied at times all the way from 95 to 120. Something had to be done, so the plug referred to above was dug out, and engine oil applied freely, and it was then that the band began to play. Of all the dins in Christendom that governor made the worst, and the more oil that was used the louder the din. But the control was fine. The volt meter hand would stand exactly on the dot regardless of variations of steam pressure. But that noise was something awful.

There was a clear, distinct tone, about D sharp on the violin, only much louder, there were old dish pans, old cows bells, a few sections of stove pipe, and the regulation horse fiddle. It reminded the writer of an old fashioned charivari band of 50 years ago in the back woods.

The use of oil in that bearing was stopped, and the hard yellow grease applied again, and as the bearing filled with the hard grease the noise in proportion decreased, and at this time the conditions are nearly normal.

I might explain, that while the awful din was at its height, several very careful examinations were made, and not a thing was out of place, or in position in anyway to cause trouble. The tension spring was removed several times from the governor, and the latter worked by hand, but all appeared to be in first class condition. What made the noise? S. S. S.

THREE-WIRE UNDERGROUND CONSTRUCTION

IN 3-wire underground installations, it is preferable, in my estimation, to use a good grade of rubber-covered double braid or asbestos covered duplex wire in a fibre duct for the outside wires, rather than lead covered wire in a metal pipe line.

In places where feeders are carried underground for a distance from the sub-station or generating plant and then to overhead construction in an alley or shop district, lightning will oftentimes come in on the overhead lines, and on reaching the underground section of the feeder, break through the insulation between the copper conductors and the grounded lead cable sheath, and produce a short circuit; whereas, in the other case, the insulating value of the fibre duct in addition to the higher insulating value of the rubber-covered, double braid or asbestos covered wire would offset that tendency a great deal.

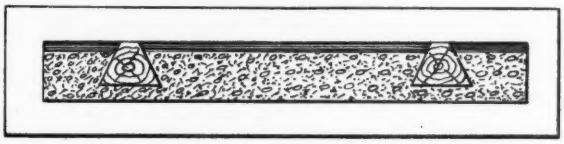
Another fact in favor of the latter method of installation, is that it offers greater resistance to electrolysis. With lead-covered cables, trouble is caused, more or less, by return current from other sources, such as street railway and other power circuits using gounded return feeders.

Some men state that fibre duct will succumb quickly to moisture, but there is fibre tubing on the markets today that will withstand almost any conditions, and if the joints, whether threaded or sleeve joints, are put together carefully and painted well with compound or asphaltum paint, there is little danger from leakage. H. J. U.

FOUNDATIONS FOR SMALL MOTORS

RECENTLY the writer had occasion to install a 1½-hp. motor direct connected to a vacuum cleaning machine. The machine was put in a small basement room where there was no floor. The ground was excavated to a depth of about 5 in. and the space filled in with concrete, that served the double purpose of a floor for the room, and a foundation for the motor.

At the time the foundation was built the motor base was not available for embedding the usual holding down



FOUNDATION FOR SMALL MOTOR

bolts in the concrete, and only an approximate layout of the bolt holes was known. The problem was solved by embedding 2 by 4-in. sticks of timber in the foundation, in the approximate location of the bolt holes, as shown in the accompanying sketch. The sticks were chamfered off on the top so that the concrete would hold them from pulling out. When the motor was erected, the base was fastened down by putting lag screws down into these timbers.

The concrete mixture was made from 1 part Portland cement, 2 parts sand, and 5 parts of gravel. The top of the foundation was finished off with a mixture of half sand and half cement. H. M. Nichols.

CRACKED STEAM PUMP CYLINDER

I WAS looking at a small pump used as an auxiliary for feeding the boiler in a certain plant, and as the steam head was off and the engineer fixing on a fresh head gasket, we were drawn into conversation over this little item of the engine room.

It appears that a few years ago the cylinder, through some mishap, became cracked and for a time put the pump out of commission. There was a duplex pump doing the work alright, but of course the engineer wanted this special pump fixed up. It was a single cylinder, old type pump, and according to the employers not worth fixing up, but they did not supply the engineer with a new one in its place. It lay idle for some time, although now it could have been brazed and bored out anew.

One day the engineer, in going through some odd stock, discovered a small length of 4-in. flue tubing. This happened to be a good tight fit in the same cylinder, and it gave him an idea. He cut the flue the exact length of the cylinder and marked off the ports. It did not take long and was not a difficult job to cut these ports and have the flue "snug" home in the cracked cylinder. It would have been an easy matter now to have bored out the inside of the smaller sized cylinder and turned down the piston to size, but why this was not done can easily be understood, considering the attitude of the employers.

In his spare time the engineer filed the inside true, as the flue was quite round and was only a little rough inside. The next item was the piston and rings. The former did not require much done to it, as the former cylinder some time or other had been bored out a little and the original heads left. The ring, which was a simple cast-iron spring, was also soon fixed to make a steam-tight job, and fitted between the leaders of the piston. It was a satisfactory job as far as was desired, as it was only used while overhauling the other pump, and this simple little repair may appeal to many who would like to fix up a scrap pump for their own good. Wankories.

A NEW PUMP MANUFACTURER

SOME short time ago, the writer having a half day layoff to celebrate Thanksgiving, and being a comparative stranger in the city at that time, had the freak desire to take a sight-seeing tour, and hearing a lot told about the street-car power plant, calculated that he would go and have a look at it.

Arriving at the plant, and having a natural diffidence about entering strange places too suddenly, he lingered in the front door of the engine room, taking in the situation and trying to imagine what kind of a reception was in store. No one was in sight to bid or forbid, and after waiting until patience had passed the virtuous stage and become irritating, in I walked.

Engine and generator were busy after a fashion, and were taking great satisfaction in making known their important efforts. You could hear them for a block.

There seemed to be nothing particularly noteworthy about them, and spying around for something more satisfactory to investigate, in the corner by the boiler room door a little duplex pump was found, just about the size to make a watch charm for a husky fireman. It was a cute little affair, and was working so nicely that it was a pleasure to watch it, and while stooping over it, looking for the nameplate and enjoying the smooth working, a little, old, gray-haired man entered from the boiler room, looking as if he had recently dined on a mess of sour pickles.

I straightened up, greeted him pleasantly with a "Good morning, sir," to which he replied, "Mornin."

"This is a nice working little pump you have here."

"Oh yes, it's good enough."

"I was just looking for the name plate. Can you tell me who made it?"

"That's a duplex pump."

"Yes, I know; but I had a desire to know who made it."

"Wall, old man Duplex himself made it."

O. M.

ZINC FOR BOILERS

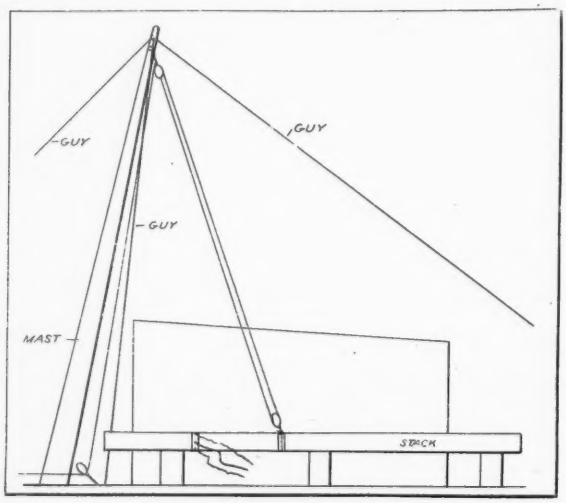
IN answer to the question asked by K. R., in Practical Engineer, regarding the use of zinc in cleaning tubes and stacks, I wish to say that I have experimented with zinc in both return tubular boilers and in coal burning stoves in my home, and although the experiment was very successful in the latter case, thoroughly cleaning the metal piping and brick chimney, I cannot say as much for the experiment in boilers. Although the light outer coating of soot was

completely burned and removed, the hard underlying scale was not affected. In my experience, I have found that a good flue sweeper and a liberal application of elbow grease have proved to be the most efficient and satisfactory agent for the cleaning of flues and stacks.

H. E. Taylor.

RAISING A STACK

I HAVE had some experience in raising steel stacks and think the following might be of some help to someone. The first thing to do is get the stack as near as possible to the point where it is to be raised. Now set a gin pole or mast within a few feet of the base of stack, guy the mast 3 or 4 ways so as to keep it steady. The mast should reach a little higher than the center of the stack when it is in position, or in other words the top of the mast should extend up about 35 ft. on a 50-ft. stack.



METHOD OF RAISING STACK

To the top of the mast attach a good strong rope fall strong enough to lift the stack. Attach the stack guy to stack while it is on the ground so when the stack is up in place you can anchor the guys to hold the stack in place.

Now put a rope sling around the stack 6 to 10 ft. above the center, so the bottom end will be heavy and when the stack is raised from the ground the stack will hang almost vertical and when raised high enough it can be swung into place and lowered through hole in the roof.

To raise the stack easily, a capstan and a horse attached to it is necessary. Morrison Merrill.

COST OF A CHECK VALVE

A VERY singular accident happened recently in the power plant of a large Pittsburgh office building, one of the elevator motors running off backwards. The power is furnished by 4 large gas engines and the elevators are hydraulic, the water being pumped by motor-driven screw pumps. The pumps have been in service about 10 yr., and recently when making some repairs on the pump in question it was found that valves in the valve chamber were nearly all loose and the studs that hold them mostly all broken off by being eaten away by the water. As these valves have no purpose in a screw pump, except to hold the water when the pump is stopped, the engineers removed them entirely, which gave a freer discharge for the pump. This pump had worked along successfully this way for about a month when one evening recently the power load of this plant was being carried on one engine and the light load on another engine, the 2 loads being separated. The night engineer added to the power load a refrigerating machine which is only run at night. This additional load brought the engine up to full load. Soon after this load came on one cylinder of the 3-cylinder engine which was hauling the power load commenced to miss explosions, causing the engine to slow down and before the refrigerating plant could be shut off the engine stopped, thus cutting the current off from all motors.

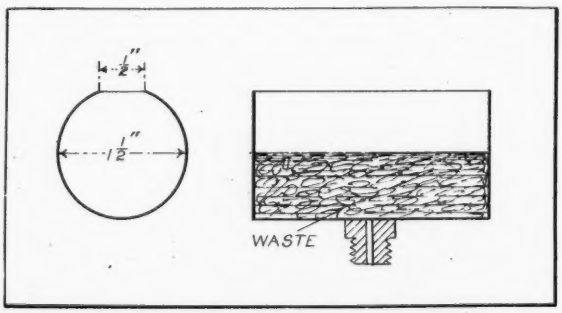
The elevator pump in question was operated by a 60-hp. motor, so when the current went off this motor the pressure of water on the screws of the pump started to turn it backwards, but it not only continued to turn backwards, but kept on increasing in speed. The pump operates at a speed of 800 r. p. m., but it is claimed that before the water was shut off it had attained a speed of more than 2000 r. p. m.; in fact, the speed was so high that the centrifugal force of the armature coils caused them to swell out so that they burst the wrapping bands and the ends of the coils flared out in a bell shape until they began to rub on the field coils, wearing holes in each of the field coils. The armature coils were built up out of ¼ by ⅜-in. copper bar stock, and to get the ends of the coils down again in order to get the armature out of the poles, required nearly an hour's time with a heavy block of wood and a sledge hammer. The armature and field coils had to be sent to a repair shop where the field coils had to be partly rewound, and the armature coils all had to be lifted out and reinsulated.

Since that occurrence, the owners have arranged to install a check valve in their discharge pipe to stop the water in case the motor stops again.

L. M. Johnson.

ECCENTRIC OILER

TO MAKE a cheap eccentric oiler for a high-speed engine, take a piece of sheet brass or tin, ½ in. longer than the travel of the valve, bend it to 1½ in. in the middle and ½ in. at the top, solder ends upon



HOME-MADE ECCENTRIC OILER

it and take the bottom of an old drop oil cup and solder on the bottom, punch an oil hole in it, fill about half full of waste. Wm. Carpenter.

EMERGENCY STARTING OF CORLISS ENGINE

A. H. Strong brings up a subject in the November issue that I have wondered has not been brought up oftener, that of, "What to do in Emergencies." I have heard engineers remark several times, "Anybody

can start an engine and run it while everything is running alright," which is pretty nearly true, but it shows up a man in his true form when something out of the ordinary occurs and he has to think and act P. D. Q.

While I was oiling I saw an emergency overcome which I never forgot. The main engine in the plant was a Corliss of 1000 hp. direct connected to a generator furnishing power for a large boiler and machine repair shop. The engine when shut down would invariably stop when the high-pressure pin was near the bottom center, but could very often be started by opening the throttle; but this morning this engine stopped on the dead center. The engineer opened the bypass to the receiver but no steam entered.

Finally he concluded that the disk had come off the stem from some cause or other. I was directed to unhook the high-pressure wrist plate and hook up the steam valve for the head end, while he opened the throttle. The steam passed into the cylinder through the exhaust valve into the receiver and to the low-pressure cylinder, and the engine started alright.

Mr. Strong's mishap was somewhat different, but, if I were in his place at that time, I believe I should have secured a long bar of iron or wood and raised the governor and slipped in the pin, which would have placed the steam hooks in a position to open the valve as soon as the engine moved. I would then have attached a monkey wrench to the dashpot rod leading to the valve for the opposite end of the cylinder to that at which the piston was. Opening this valve would let steam through the cylinder and the exhaust valve, to the receiver and thence to the low-pressure cylinder, which piston being on the quarter, would get steam enough to turn her over.

As to the second emergency I have never had the misfortune of burning any pin boxes out; but should I ever have, and the engine were needed as urgently as it was in his case, I believe my course of action would be as follows, provided there are no extra boxes around: I would take the boxes out as quickly as possible; while doing this I would have my helper get some sheet lead, copper, or brass, whichever was the handiest, cut pieces to fit each box to the thickness of the former babbitt, put the boxes back, give the pin a bath of oil and start up. I believe that the way just mentioned would save the "heat from being froze up." Fred Wagner.

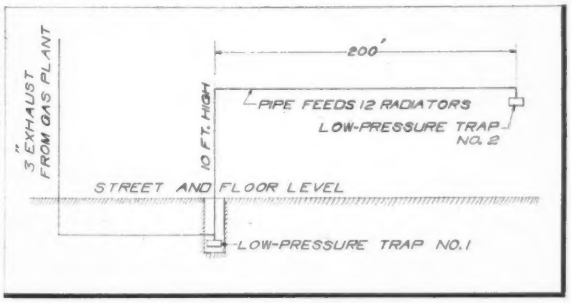
ONE OR TWO TRAPS

ENCLOSED is a rough diagram of our heating apparatus. We heat our plant by the Paul vacuum system, using exhaust steam which we receive from the gas plant across the street. The vacuum pump is situated in our own plant, there being also a small live steam pipe coming from the gas plant for the purpose of operating the vacuum pump.

You will note that we have a pit in which is situated a low-pressure trap at the lowest point on the exhaust line, so as to get rid of any condensation that might occur. Now the trouble is that it is impossible to make this pit water proof; that is, water continually leaks in, and when it gets up to the steam pipe, of course it generates considerable steam from contact with the pipe, which causes us considerable trouble.

We closed the valve to the low-pressure trap in the pit about 4 days ago and the heating system has been working just the same as when the trap was open. Of course, with this valve closed there is no way for condensation to get out of the pipe unless it is drawn up through the 10-ft. pipe and, running through the 200-ft. pipe line, is discharged at low-pressure trap number 2.

We would like to know if it is possible with a vacuum of 14.7 lb. being created in our building in the 200-ft. pipe line and all radiators to get suction whereby the condensation is drawn up through the main pipe. If this is possible, we see no reason why we could not remove our low-pressure trap in the pit and fill the pit up entirely, thus doing away with all the trouble we have been having.



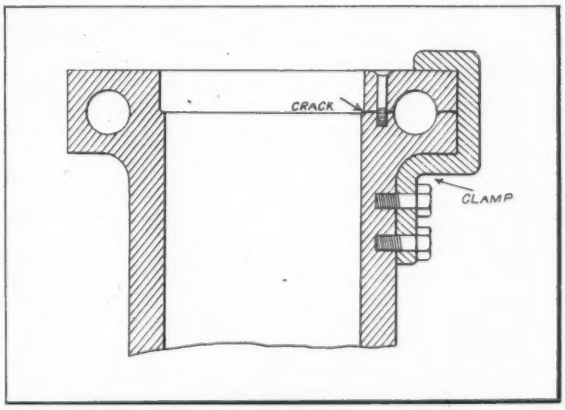
ARRANGEMENT OF HEATING LINE WITH 2 TRAPS

We would like the opinion of readers.

B. C. Henry.

CYLINDER REPAIR

THE piston rod of the steam end of our Corliss engine, which operates an ice machine, broke and went through the top head. In so doing it broke all the bolts and cracked the cast-iron cylinder through the valve port.



REPAIR FOR CORLISS ENGINE CYLINDER

The sketch herewith shows how I repaired it, by putting on a clamp and boring and tapping out a hole into which a bolt was inserted. Martin McGerry.

TOO PURE FOR BOILER FEED

AN old negro fireman being asked by the boiler inspector if the water from a certain well was pure, replied: "Yessah! This yer water has been scandalized by the best gymnastic in the county, and he do say, he do, as how it muntain 10 lb. of extra hide acid, 10 parts er cowbonic acid, and the balance am clare hydrophobia. Yessah! He say it am sure enough pure."

HE WHO LAUNCHES into engineering at the mouth of the river soon encounters overwhelming breakers.

BY-PRODUCT ICE

A SOURCE OF REVENUE FOR LIGHTING PLANTS

PROFESSOR GEORGE H. MORSE, in a recent paper before the Nebraska Electric Association, gave estimates on an assumed case of an electric-lighting plant operating with and without an auxiliary ice plant, using as illustration conditions approximating closely those found in a certain lighting plant in Nebraska. The company serves a town of 5000 inhabitants. Coal costs $4 a ton, and water 7 cents for 1000 gal. The plant cost $40,000, including the distribution system.

Peak load is 90 kw., and the yearly output 306,000 kw-hr. The plant runs 24 hr. a day, with daily output in summer of 770 kw-hr., and in winter 930 kw.-hr. It has compound condensing engines of the high-speed type and a cooling tower is employed for cooling the condensing water.

Average coal consumption per kilowatt-hr. is 10 lb. when running condensing and 12 lb. noncondensing. The plant labor consists of one night and one day engineer in summer and a third engineer in winter, the men doing their own firing.

Yearly expenses of operating this plant condensing, including a manager at $2000 and all labor on lines and in plant, together with water, oil, waste, plant repairs, taxes, fire, boiler and employer's liability insurance, office and legal expenses, are as follows:

Expenses as above	$10,000
1530 tons of coal at $4	6,120
Depreciation on $40,000 at 8 per cent	3,200
Total	$19,320

Yearly receipts from all sources are $25,000; so that the plant returns a net income on the investment of 14.2 per cent.

Professor Morse then assumes that a 10-ton by-product ice plant is added, which in the latitude of Nebraska will be used to make ice for 6 months in the year, remaining idle the other 6 months.

This 10-ton exhaust-steam ice plant complete with machinery and chemicals in place, including a one-story brick building, 24 by 53 ft., and an ice-storage room for 2 days' supply, will cost about $15,356. The only difference in the cost of operation, so far as the lighting plant is concerned, will be the 2 extra pounds of coal per kilowatt-hour made necessary through operating the engines noncondensing, this extra coal being charged against the ice plant.

The quantity of coal thus consumed during 6 months will be 131 tons, which, at $4 per ton, will be $524. Items of cost involved in the operation of the ice plant are as follows:

131 tons of coal at $4	$ 524.00
Annual depreciation on $15,356 at 10 per cent.	1,535.60
7200 gal. of cooling water a day for 180 days at 7 cents per 1000 gal.	907.20
One night and one day attendant in ice plant for 180 days at $2.50 each	900.00
Two teams and 2 drivers, 180 days at $5 each.	1,800.00
Four distributors of ice from wagons, 180 days at $2.50 each	1,800.00
Taxes and insurance	350.00
Rent of ground at $20 a month	240.00
Management and clerical work	1,000.00
Total	$9,056.80

Gross income from 1800 tons of ice at 40 cents a 100 lb., $14,400. Annual cost of operating the combined lighting and ice plant, $28,376.80. Yearly receipts of combined plant, $39,400. Net annual income on total investment of $55,356 in combined plant is 20 per cent, as compared with 14.2 per cent from lighting plant alone.

FIGHTING WITH THE SPIRIT

THE following narrative of an interesting struggle and victory, is given by John C. Weaver, in the Cold Storage and Ice Trade Journal:

It's nice to be snoozing quietly in your downy, all curled up warm, with the wind howling outside and the rain beating down. Gives one such a feeling of satisfaction that he doesn't have to be out in it. But when you have to turn out after the first half nap and pile out into the night at 12:30 with the wind and rain to make things interesting, it doesn't leave a pleasant taste or the happiest possible frame of mind.

And so it happened that when I got to the plant in response to a call to fix a bad leak in one of the ice tanks of a 55-ton absorption machine, I was in a fighting mood. Probably my frame of mind showed

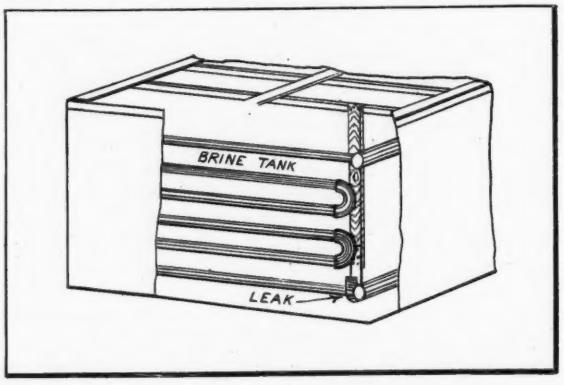


FIG. 1. THE TEMPORARY HOOK AND REPAIR

on my face, for everybody jumped to attention when I came into the plant and all started to tell at once what and how it happened.

There was no need of telling what was the trouble, for the ammonia could be heard rumbling in the brine near one corner of the tank. The only question was just whereabouts that infernal leak had broken loose.

All kinds of suggestions were put forth, emptying the brine tank being the least foolish. But what was the use of that, for the plant must be kept running I jumped for the kid oiler, and said: "Here, get me a stick;" and he jumped and started for the junk hole, and brought back a piece of hemlock 2 by 4. He didn't seem to comprehend what was going through my mind, apparently not being gifted with mind reading or second sight, so I was obliged to explain myself in detail, as follows:

"Here, you thickheaded young scrap. I don't want a saw log; take that wood bar back in the junk hole, and bring me out a stick, s-t-i-c-k, do you hear? Something about 4 ft. long and a half by ⅞-in.; a piece of edging, a batten strip, or a lath, or something; now hustle!"

Well, he came back quicker than he did the first time, with the right kind of a stick, and I commenced feeling down in the tank for the leak at the place where it seemed to be growling the loudest. I could feel

the blow all right in the second coil, close up to the bottom manifold, and from the feel on both sides it seemed to be blowing downward, but I wanted to make absolutely sure before going ahead with any attempt at a repair.

By this time the whole force, except one fireman, was standing around watching to see how the boss was going to "plug the hole," and I started the assistant to make a piece of hoop iron into a hook to go on the end of my stick.

"Here, you, take this stick out into the shop and make a hook out of that heavy hoop iron, to just fit around a 1-in. pipe; fasten it to the end of the stick good and strong. And then take a strip of that 1/16-in. sheet packing and wrap it around the hook and bind it on with strings; and then get it back here. Don't waste any time either."

"Now you kid, hustle over to the blacksmith shop and get a piece of ⅝-in. round iron. Start up the forge and get the end hot for about 5 in. Be sure

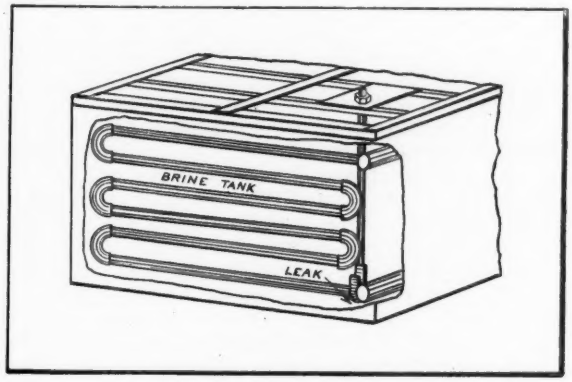


FIG. 2. THE IRON HOOK IN PLACE

that your whole piece of iron is a foot longer than this stick, and I'll be out and see you before long."

Having thus started my forces to work, I set to figuring just what was the best method of handling the proposition, but I did not think long, for the assistant was soon back with the temporary hook, and by lowering this into the brine tank and drawing it up under the pipe where I thought the leak was, I hit the right spot first dash out of the pot. I then pulled hard upon the hook and held it in position while I drove a couple of nails through the stick into one of the wooden tank frames, and this almost entirely stopped the leak.

I then started the assistant for the machine and told him: "Get that back pressure down to a point where it will cut the leakage down, but be sure not to get it so low that any brine will be drawn in; somewhere between 3 and 4 lb. ought to be about right." He went out and cut down his back pressure until the pressure was just above 3 lb., when the leakage practically ceased.

This put things in shape so that no ammonia was escaping, and I went to see how the cub was getting on out in the blacksmith shop. For a wonder he had obeyed orders and had a good forge fire with about 5 in. of a ⅝-in. round iron, 5 ft. long, all ready for working. I flattened this end out to a ¼ in. thick by 1¼ in. wide, and then bent a hook from this flattened end to suit the diameter of the inch pipe, leaving the hook something deeper than a semi-circle, and with a little allowance for packing inside the hook.

On the other end of the rod a thread was cut about 5 in. long, as shown in the sketch. Sheet packing was then fastened inside the hook and secured with string, and we were ready to make the change from the temporary hook to the other one. The stick with hoop iron was removed and the new iron hook adjusted around the leaking pipe with the threaded end running through a hole in a piece of 2 by 4 timber, the cub with a grin bringing back to me from the junk hole the same piece that I had made him return, and which was laid across the tank top cover. Then by putting on a washer and nut we drew up tight to force the hook against the leak.

I felt sure that this would hold, and so said to the assistant: "All right, open her up and bring the back pressure up to 20 lb." This was the back pressure that we usually carried, and after we had got started, we found no sign of a leak, and ran that way until we got a supply of ice ahead, and then froze the tank up solid, drew out all the cans, and fitted a new section of pipe in place of that where the leak had started.

It wasn't a big job and didn't take a whole lot of time or gray matter, but, if I had not got that leak stopped in time, there would have been a loss of 60 tons of ice, as well as a considerable quantity of ammonia, which were saved by this simple device.

TOO GENEROUS WITH AMMONIA

IN the operation of a refrigeration plant it is possible to be too free with the supply of ammonia as well as to be too scarce. In a case which has recently come to our attention the conditions were as follows: In a steam-driven compressor plant the steam cylinder was 20 by 21 in. and the compressor cylinder 14 by 24, with double pipe counter current condensers. The plant made ice and had a tank containing 320 300-lb. cans in it, and also furnished refrigeration for an ice cream hardening room cooled by air blast. The plant was started up with a charge of 1200 lb. of ammonia and ran splendidly, keeping the temperature down in both ice tank and ice cream room, even when the machine was not running up to the speed which was 68 r.p.m.

With improvement of business it was necessary to run the plant 24 hr. a day and 400 lb. of new ammonia was added and the compressor kept up to full speed, but even at this and using well water, of which the supply was plentiful, at 64 deg. F., the pressure on the high side ran up to 200 lb., while on the low side it was difficult to get it above 12 or 15 lb. As first operated, the discharge arm on the compressor would run too cool if the expansion valve was not carefully watched, but with added load the temperature of the discharge arm was 330 deg. The question arose as to the size of condensers, these being 4 stands, 12 pipes high of 2-in. and 1¼-in. pipes, 17½ ft. long, which is obviously plenty large enough for the capacity of the compressor. Difficulty could not be laid to the operation of the plant, as it was regularly and carefully taken care of in every way and was in good condition.

Study of the operating conditions and the difficulties encountered led to the decision that there is too much ammonia in the system. This would, of course, crowd the system and give insufficient room for the operations of expansion, condensation and compression. The remedy would be, of course, to draw off a part of the ammonia, taking out 100 lb. at a time until the point of satisfactory operation was reached.

FINDING THE DECIMAL POINT

KEEPING TRACK OF THIS ELUSIVE DOT WHEN FIGURING WITH PENCIL OR SLIDE RULE

IN MAKING COMPUTATIONS which involve the use of decimals, there is frequently some confusion in finding where the decimal point belongs. The danger of misplacing it is illustrated by the old story of the bridge designer whose bridge fell down when about three-quarters finished, and who on seeking the cause went carefully over his computations and finally exclaimed, "Confound that decimal point!" In the course of figuring he had misplaced it, and the bridge was only 1/10 as strong as he had intended, which brought a breaking strain on an important member of the structure.

For Multiplication

IN many computations, the reasonable value of the result will tell whether the decimal point is rightly placed or not; but in others where sizes are unfamiliar, we must rely on the accuracy of the figures for the correctness of the result. In the case of multiplication, while it needs some care to be sure that the decimal places are counted accurately, the rule is simple enough, namely to "point off as many places

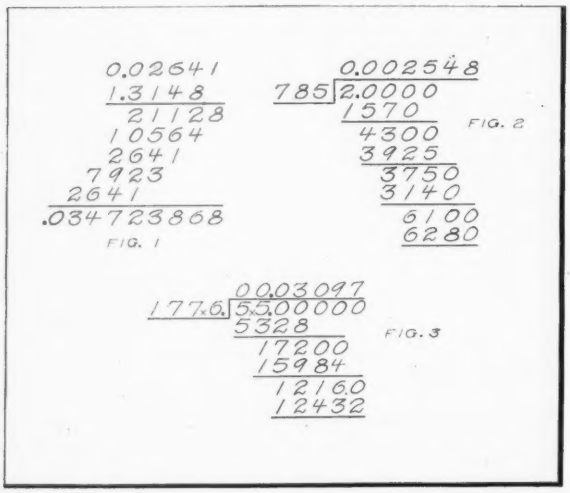


FIG. 1. THE DECIMAL IN MULTIPLICATION

FIG. 2. SIMPLE METHOD FOR FINDING THE DECIMAL POINT IN DIVISION

FIG. 3. WHEN BOTH NUMBERS OF A DIVISION CONTAIN DECIMALS

in the product as the sum of the places in multiplier and the number multiplied." For instance in figuring the volume of 1.3148 lb. of steam at 10 lb. absolute pressure, we find that the volume of one pound, as given in the steam tables, is, from the November data sheet, 0.02641 cu. ft. The operation of multiplying is then as shown in Fig. 1, and counting the decimal places in the number and the multiplier, we find that there are 9 altogether, which means 9 decimal places in the result, giving us 1 cipher in front of the 3 and then the decimal point.

For Division

IN the case of division, the proper placing of the decimal point is not so easily expressed by rule, and a little kink in mechanical performances of the operation is helpful. Take the case of 2 to be divided by 785. If we set down the 2 and then the 785 to the left of it, divided by a line as in the usual manner, and above the 2 draw a horizontal line, we may then add as many ciphers after the decimal point at the right of the 2 as needed for our purpose, and above the 2 we put a cipher because our divisor is contained in 2, zero times. We then place a decimal point above the decimal point in the dividend and proceed with another cipher, because the 785 is contained zero times in 20, zero times in 200, and 2 times in 2000. The method is shown in Fig. 2.

In the case where a number containing a decimal is to be divided by another one containing a decimal there is an additional step. If it be required to find the number of pounds of steam at 26 in. vacuum, which will be contained in 5.5 cu. ft., we find from the data sheet, November tables, that 1 lb. occupies 177.6 cu. ft. To find the pounds in 5.5 cu. ft. we must, therefore, divide 5.5 by 177.6.

As before, we put down the 5.5, then draw a vertical line to the left and put down the divisor; we add zeros to the dividend as may be required, and then move decimal points in both divisor and dividend to the right until the divisor becomes a whole number, putting a cross in the former position of the decimal point to show where it was originally located. We then proceed as before, putting the decimal point in the quotient above the new decimal point in the dividend. The continuation of the calculation is shown in Fig. 3.

For Combined Operations

THESE methods cover all cases for single multiplication and division, and for operations that are carried on in series, that is one after the other. There are, however, certain calculations which are made from formulas or equations in which we have indicated a series of multiplications and divisions, and where cancelation of factors is used. Take the case of the familiar horsepower formula represented by $\frac{PLAN}{33000}$, in which P is the mean effective pressure in a steam engine cylinder, L the length of the stroke in feet, A the area of the piston in square inches, and N the number of working strokes per minute; a considerable amount of arithmetical work can frequently be saved by indicating the entire series of multiplications and divisions and then crossing out factors which are common to numerator and denominator.

Assume that the mean effective pressure is 25 lb., the length of stroke 4 ft., diameter of piston 24 in., and r.p.m. 75. We then have all the factors of the horsepower formula, except the area of the piston which is found by squaring the diameter, multiplying by 3.1416, and dividing by 4. Substituting the values then in the formula, we get the expression as shown in Fig. 4, the number of working strokes being equal to the r.p.m. when only one end of the cylinder is considered.

Now cancelling out like factors in numerator and denominator, we have both 4's out, the factor 25 will cancel into 33000, leaving 1320, the factor 4 will cancel into 24 leaving 6, and into 1320 leaving 335, and the factor 5 into 75, leaving 15, and into 335 leaving 67. We can readily multiply 24 by 6 mentally, giving 124, and then to multiply by 15 we have 10 times 124 is 1240, and half that will be 5 times 124 or 620, and the sum of the two gives 1860. Then by long multiplication we take the product of 3.1416 and 1860, giving, with 4 places pointed off, 5843.3760. Performing the division and locating the decimal point by the method already given, we get 87.21 as the horsepower.

The experienced engineer will know from the dimensions and data given whether this is about right for the horsepower or not, but for the novice there might be a delightful state of uncertainty whether it ought to be 87 or 872 hp., as the loss of the cipher anywhere in the cancellation would throw the position of the decimal point out of its proper place. It is useful, therefore, to make a rough check to prove the decimal point's position, as shown at the bottom of Fig. 4.

Fill out the formula raising or lowering values to bring them to the nearest figure having a zero or a 5 as the last digit, and taking care to raise about as many factors as are lowered. In this way an expression will be secured which can be quickly canceled to a few simple factors that can be mentally multiplied to indicate about the result that ought to be obtained, the process in the present instance being as follows:

In the numerator we have 25 and 4; then substitute 25 for 24, and 20 for the second 24, 3 for 3.1416 and 70 for 75. In the denominator the only change is to use 30,000 instead of 33,000. Then 4 times 25 in the numerator gives 100 which cancels 2 ciphers in the denominator. The cipher in the 20 cancels another cipher in the denominator, and that of 70 the fourth cipher. Then we have 3 times 4 in the denominator is 12, which cancels approximately twice into 25, leaving us 4 simple factors, and we have $2\times2\times3\times7$, gives 84, showing that our result, 87.4, is correctly pointed off.

For the Slide Rule

COMING now to the case of the slide rule, we must remember that the slide rule knows no decimal point, that is, in making slide rule computations, 125, 1250, or 12500, or 1.25 are all the same so far as the slide rule manipulations and readings are concerned. It is necessary, therefore, to have some rule for locating the decimal point, and we may do this by the regular method for arithmetical multiplication or division, or by a special method which applies only to the rule.

Take the case of Fig. 1. It is necessary to remember that the slide rule does not read to more than 4 significant figures, and that it is not important that it should do so, for in practically all engineering computations we are working with values which depend on test observation, and these observations are not accurate to more than ½ of 1 per cent. It follows, therefore, that the slide rule is not a good instrument on which to figure the interest on a million dollars, but we are assuming that the interest on a million dollars is of only academic interest to the readers of Practical Engineer.

Put 1 on the C scale at 2641 on the D scale; remember that each division between the marks of the 2 to 4 section of the rule represents 2 points, and the last figure 1 means that the 1 on the C scale is just a hair to the right of the 264 division of the D scale. We then carry the runner to 131 on the C scale and note that the remaining figures, 48, is practically the same as 50, so that the runner will stand half way between 131 and 132. Under the runner on scale D we shall then find 347 and a small fraction which we would estimate at 3.

From Fig. 1 we find that the absolutely accurate answer is 34723, but 3473 is as close as we can expect to come to it with a slide rule reading. It is evident that with only these 4 figures known, finding the decimal point by the rule for arithmetical multiplication is out of the question.

Many rules have been devised for finding the decimal point in slide rule computations, but perhaps the simplest is that given by Wm. Cox. The index of any number is the number of figures in the integral part of the number; that is, the part to the left of

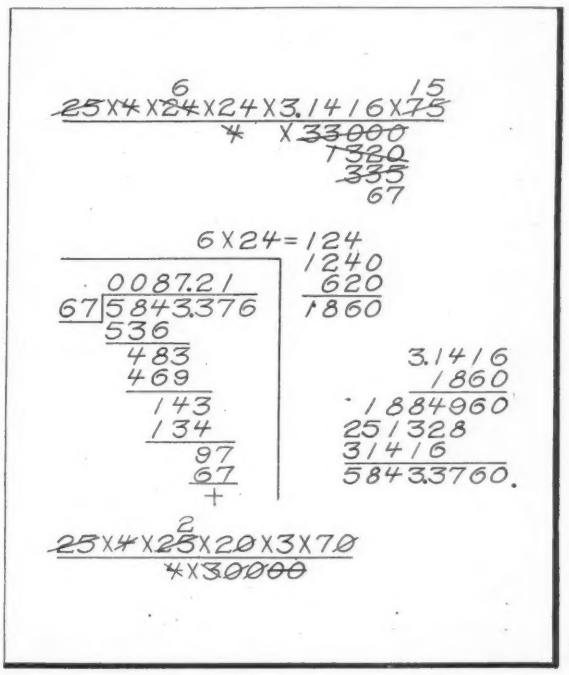


FIG. 4. USING THE HORSEPOWER FORMULA BY CANCELLATION

the decimal point. The index of 125 would, therefore, be 3, of 1250, 4, of 12.5, 2, of 1.25, 1 of 0.125, 0. If we go still further we have to resort to the negative index; that is, 0.0125 has 1 place less than nothing to the left of the decimal point and the index is, therefore —1. 0.00125 would have the index —2, and so on.

The rule given by Cox is that for multiplication, if the final product is read with the slide projecting to the left, the index of the product is the sum of the indexes of the factors, but if the slide is projecting to the right, the index of the product is the sum of the indexes of the 2 factors, less 1. In the example which we have just worked, Fig. 1, the index of 0.02641 is minus 1, and the index of 1.3148 is 1. The product is read with the slide projecting to the right, therefore the index for the product is minus 1 plus 1, which gives 0, less 1 equals —1, which indicates that there is one cipher to the right of the decimal point, giving 0.03473 as the product.

In case we want to know the foot pounds developed in a minute by an engine giving 8.7 hp., we

would multiply 87 by 33,000, which for the slide rule is 33. Setting 1 on the C scale to 87 on the D scale, we set the runner at 33 on the C scale and below it on the D scale we read 2873, and the question arises, where is the decimal point. The index of 33,000 is 5; the index of 8.7 is 1; the answer is read with the slide projecting to the left, hence the index of the product will be the sum of the indexes of the factors, or 5 plus 1 equals 6, and there will be 6 places to the left of the decimal point, or the number will be 287,300.

For division, Cox gives the rule, if the quotient is read with the slide projecting to the left, the index will be the index of the dividend minus that of the divisor. If the slide projects to the right when reading the quotient, the index of the quotient is the index of the dividend plus 1, less the index of the divisor.

Take as an example, Fig. 2, to divide 2 by 785. We bring the runner to 2 on the D scale, now set 785 on the C scale to the mark on the runner. Under 1 on the C scale we then find on the D scale the reading 2548, the slide projecting to the left. We then have

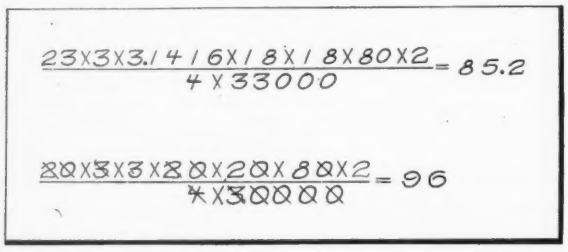


FIG. 5. CHECKING OUT THE DECIMAL POINT FOR A SLIDE RULE COMPUTATION

the index of 2 is 1, and the index of 785 is 3; subtracting 3 from 1 gives us —2. The index —2 means that there are 2 ciphers to the right of the decimal point, and the quotient becomes then 0.002548, as shown in Fig. 2.

Again, suppose that we wish to divide 62.42 by 1728. We set the runner to 6242 on the D scale, and bring 1728 on the C scale to the runner. Under 1 on the C scale, we find on the D scale the reading 361. The characteristic of 62.42 is 2, that of 1728, 4, and the quotient is read with the slide projecting to the right. We have, therefore, that 2 the index of the dividend plus 1 equals 3, and less 4 the index of the divisor, gives —1, which is the index of the quotient. This means that there is one cipher to the right of the decimal giving 0.0361 as the quotient.

Combined Slide Rule Operations

THESE rules work well enough in the case of a simple multiplication or division, but where there is a series of operations, particularly where multiplication and division are combined as is frequently the case in the slide rule computation, the carrying out of the rule becomes so involved that a determination of the decimal point position by inspection is quicker and more accurate. For the case of Fig. 1, it is evident that 1.3 times 0.02 would be still somewhere near 0.02, so that the product would evidently be 0.03473. In the case of multiplying 33,000 by 8.7, it is easy to see that 8 times 30,000 would be 240,000, which shows that the product must be 287,300. In the example of Fig. 2 it is easy enough to jot down the 2 and the and the 785 as if the division were to be performed by arithmetic, and the position of the decimal point can in this way be quickly located by inspection.

In the case of a computation by means of slide rule of the example shown in Fig. 4, it is evident that after performing the operations on the slide rule instead of by cancellation, the location of the decimal point could be quickly checked out by the method shown at the bottom of Fig. 4, for testing the accuracy of its location when doing the problem by arithmetic.

To take the case of another example on the horsepower formula, if we have a double acting engine with mean effective pressure of 23 lb., stroke of 3 ft., piston 18 in. in diameter, running at 80 r.p.m., the expression for horsepower will be as shown in Fig. 5 the number of working strokes being twice the r.p.m as the engine is double acting.

To perform the operations indicated, perform first a division and then a multiplication, then a division and then a multiplication, and then continue the multiplications until all factors have been used. The first division is 23 divided by 4. We set the runner to 23 on scale D, and bring 4 on scale C to the runner; then carry the runner to 3 on scale C, and bring 33 on scale C to the runner; then carry the runner to 3.1416 on C, which will be a trifle to the right of the 314 reading. All the divisions have now been accomplished, the remainder of the work is multiplication, and we bring 1 on C to the runner, then carry the runner to 18, bring 1 to the runner, carry the runner to 18, bring 1 at the right hand end of the slide to the runner and carry the runner to 8, then bring 1 to the runner and carry the runner to 2. Then at the runner mark read on scale D the answer, which is 852.

It remains to determine the decimal point, and this is most easily done by the same process of approximate cancellation as was used in the arithmetical computation of Fig. 4. This is indicated in the lower part of Fig. 5. We first cancel the 4 ciphers in the numerator against the 4 ciphers of the 30,000 in the denominator. One of the 3's in the numerator cancels with the 3 in the denominator, and the 4 in the denominator cancels 2 of the 2's in the numerator, leaving as factors $3\times2\times8\times2$, which is easily figured mentally to equal 96, so that it is evident that the correct result is 85.2.

As a result of years of experience using the slide rule, the writer has adopted the method of inspection and approximate cancellation as the quickest and most accurate method of determining the position of the decimal point. While the method of index is easy in a single computation, it involves keeping track of the projections of slide to right and left as the work progresses, and this takes the mind from the settings so that it is likely to cause errors in readings. Even if correctly done, it will take more time to keep track to work out the index than to perform the approximate cancellation, and that cancellation gives an approximate check on the correctness of the slide rule manipulation as well as the position of the decimal point.

NEW FEATURES at the meeting of the National Gas & Gasoline Engine Trades Association will be Engine Manufacturers' Day, Wednesday the 6th of Dec., the provision of time for inspection of exhibits, each morning being devoted to that purpose, and an open meeting for power users on Tuesday evening, Dec. 5. All meetings will be held in the Hotel Hollenden, Cleveland, Ohio, the convention lasting from the 5th to the 8th. Full information in regard to the meeting and exhibits can be obtained from Albert Stritmatter, Secretary, Cincinnati, Ohio.

FROM ENGINEER FATHER TO COALHEAVER SON

COMMENTS ON STARTING AND STICKING

MY DEAR SON:

We received your letter a few days ago and mother and I are both glad that you got a job so soon after leaving school. And we are glad also that you have got a backbone stiff enough to buck up against a tough proposition. Now right here let me say, don't get any kinks in it, for just as sure as you lose your backbone you're a goner for good.

The country is full of these spineless animals with clothes on. They're just what the chief said you was —a quitter. Now no quitter can come back home to us. We've always got room for a hustler to take a vacation back in the old home, but we haven't got any room for a MacDougal with a yellow streak.

While I am a man of peace in a general way, yet I don't believe in fighting just to start something. If you're going to fight at all, fight to stop something. Some men have a peculiar notion that their position gives them the right to bully those below them, and you must use your horse sense and judge whether or not the boss is calling you down because you need it or just because he is in a position to do so and wants to keep in practice.

If it is the first, take your medicine like a man and don't make the same mistake twice; if it is the second, the sooner you give a demonstration to the gentleman from Missouri, the better you will get along. Most bosses admire manly men; men who will stand up for what they believe to be right and are willing to fight if necessary to maintain their rightful beliefs. But no boss has any use for a man who cringes at a cross look and jumps into the job with both feet every time he says, "Hey, there!" for he knows that just as soon as his back is turned the man will be out hiding behind the feed-water heater or the coal bin, thinking up some way to get back at him.

Now, perhaps that fireman has just been spoiling for several years to have some one hand him one also. But as long as he shows his good fellowship, why forget it. If you win out over a fellow, whether you hit him a jab or two, or beat him to a good thing, don't rub it in. That only breeds enmity. And while no man who ever lived could get along without having a few enemies, yet the more friends you have the better off you are.

Don't forget that the chief is the boss. He is responsible for the wheels turning and is entitled to the respect due his position. Don't think that because he doesn't tell everybody about the plant, what he is going to do and when, that he doesn't know anything. He is, perhaps, figuring out some way to save money after you have gone home, and, if he comes around and tells you to break that coal up to the size of a hen's egg instead of the size of a goose egg, why, try and do it as near as you know how. Possibly an extra clip or 2 with the coal pick will knock a dollar or so off the daily coal bill, and, if you can help him save that dollar, you won't have so much coal to wheel in—nor ashes to wheel out.

Yet, with all this advice about respecting the position of the chief, if you have any kinks up your sleeve that you think look good and might work out in practice, go to him like a man and tell him your plan. If he is a man, he will listen; if he wont, well—keep your eyes open for another job, for there is no sense in sitting in a coach on the sidetrack, no matter how soft the seat is. Get aboard something that is moving forward.

Now, perhaps you think the chief didn't see you and your long handled ash shovel. Well, don't fool yourself. Don't think that because he doesn't come around and slap you on the back and raise your pay every time you pull off a winning stunt, that he doesn't see you.

Most bosses keep what is called the "good book." This may be a corner in the memory and it may be an actual fact. In this book are entered the bad things you do on one page, and on the other, the good things—if there are any. Occasionally they balance their books, same as any bookkeeper does, and, if the profit and loss account is on the right page, there is perhaps a raise in pay or a better job. If it is on the other page, well, perhaps there will be a vacancy next day.

Now, my son, even if you are "just wheeling in coal and wheeling out ashes," let your work be such that everything (or as near it as possible) will be entered in the "good book" to your credit. In the meantime, be good to that fireman. Perhaps he will show you the knack of twisting a No. 5 scoop so that you can put the coal where it ought to be and not in a pile near the door. And perhaps, also, you can study out by watching the fire and the steam gage and keeping an eye open for leaky flues in the back head and leaky rivets over the bridge wall, whether or not he has got onto the trick himself yet.

By the way, son, do you know yet how much coal you are burning per square foot of grate surface per hour? That will give you something to think about, evenings when you are taking a rest at the boarding house and doctoring your blistered hands. Mother sends her love to you.

Affectionately, your father,
Sandy MacDougal.

THE AMERICAN SHIP WINDLASS CO., builders of the Taylor stoker and marine equipment, such as steering gears, ship windlasses, towing machines, winches, anchors, etc., has been located for over half a century in Providence, R. I., at Waterman and E. River Sts. This plant is now being abandoned and all the business of the American Ship Windlass Co. is being removed to Philadelphia, where the company already had a large plant. To accommodate the growing business, a large foundry has recently been erected in Philadelphia. This company was established 54 years ago to manufacture the ship windlass, and since has added marine machinery, and in 1905 began the manufacture of the automatic stoker, of the underfeed type, invented by E. E. Taylor of Boston.

GEO. F. POND has been appointed manager for the Philadelphia territory by the Wheeler Condenser & Engineering Co., of Carteret, N. J., and will have his office in the Commonwealth Trust Building. Mr. Pond has had long experience in design and construction of condensing apparatus which he will place at the service of customers.

The same company has appointed Walter J. Stephan, another experienced condenser engineer, manager for the Cleveland territory, with office at 1325 Municipal Bldg.

POWER, HEAT AND WATER SUPPLY ON THE PRAIRIE

THE PLANT IN THE U. S. INDIAN SCHOOL AT FLANDREAU AND SOME CHANGES THAT WERE MADE

By W. S. Heckendorn

THIS SCHOOL IS ONE of many in which Uncle Sam is trying to give the Indian an education that will make him better able to cope with the "pale face's" ways. It is the fourth in point of size and is run free of all expense to the students.

To the disgrace of our race, many white men seem to think that the best way to get rich is to cheat the Indian out of all that he has left, 40 or 80 acres of land that Uncle Sam has given him, for a few dollars. Four hundred dollars still looks big to the Indian, and he will soon have that spent. Then he has no land and no money, and doesn't know the value of either while he does have it. The purchase price of his little plat is soon gone and then poor Lo is up against it, for he and work do not agree.

The Indian School is an effort to prepare him for taking care of himself when such an emergency arises, as well as to teach him to take care of his land in case he is shrewd enough to keep it.

The school is really a city by itself, with electric lights, steam heat, sewerage and water system, and everything to give the Indian boys a chance to learn any trade that comes along in everyday life.

The photograph and drawings give an idea of the plant for power and heating with the water tank of 1500 bbl. capacity in the rear.

Boilers are placed 18 ft. below ground level so as to get a good pull for the old direct heating and return system which was put in when the plant was built. That the system was a failure will be evident from a glance at Fig. 2, which shows the way that the piping was originally run and the present construction.

The contractor said that it was put in according to plans, and nothing was said about expansion joints; so he put it in the cheapest way for him. It was a government job and he took all the graft he could make. So the ells were put on, the pipe was screwed in, and then on to the next turn. The next connection, shown in Fig. 2, is the arrangement as it was put in 2 years ago when installing the vacuum system. The old line was put out of business 7 yr. ago by running an independent boiler in the third building from the plant. The school building already had one, and the second building was connected to the first building with a 3-in. line which carried 15 lb. steam pressure. It was used that way for 5 yr. with good success, compared to the way things were before.

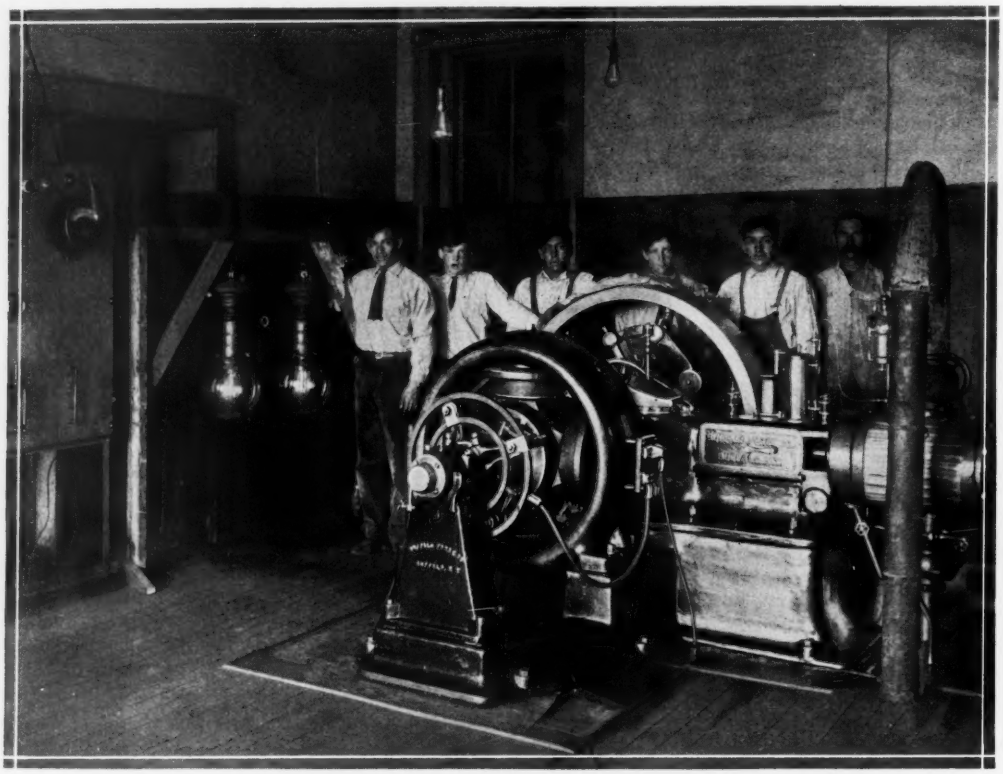


FIG. 6. ENGINE, CORNER OF SWITCHBOARD, AND STATION CREW

The Old Plant

WE had 2 Star boilers, leaking around the doors so that the fire was out for 12 or 14 in. back from the doors, and there was an ordinary bridge wall instead of a brick baffle wall up to the baffle plate. The

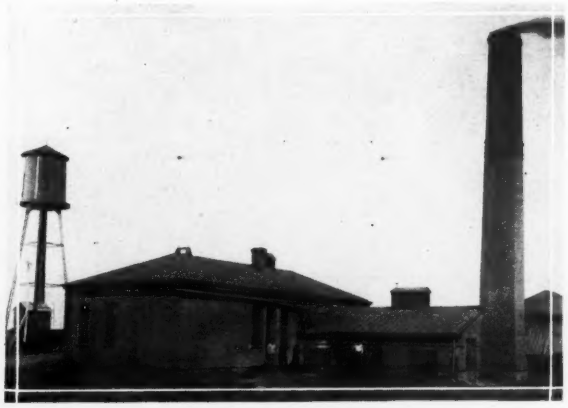


FIG. 1. EXTERIOR OF PLANT AND WATER TANK

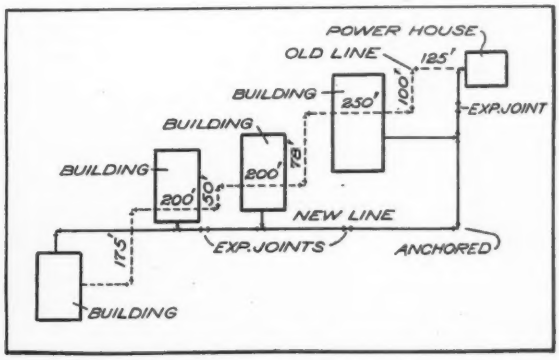


FIG. 2. ARRANGEMENT OF OLD AND NEW HEATING LINES

fire simply shot over the bridge wall, up through the tubes, and then to the stack, instead of making several passes across the tubes as it should have done. The result was 2000 tons of coal burned in one year.

Well, the first thing for me was to get under there and brick up the hole; that night I did the work and the boy who did the firing used 1/3 less coal and hp. engine with no lighting load, and couldn't keep warm. That's one of the strange things one sees when he goes from place to place.

There was one other boiler, a 54 in. by 16 ft. return tubular, and we took out all the flues in this and put in 4 boys with hammers and chisels to chip out 1000 lb. of hard scale. On the back head it was like chipping iron, it was so hard with lime. By dint of hard work and long suffering we finally got the full 1000 lb. as weighed up on the superintendent's scales.

Rearranging

NEXT the engine was moved from the boiler room downstairs into a room adjoining and upstairs, a job which took 4 days and gave a good, light, airy

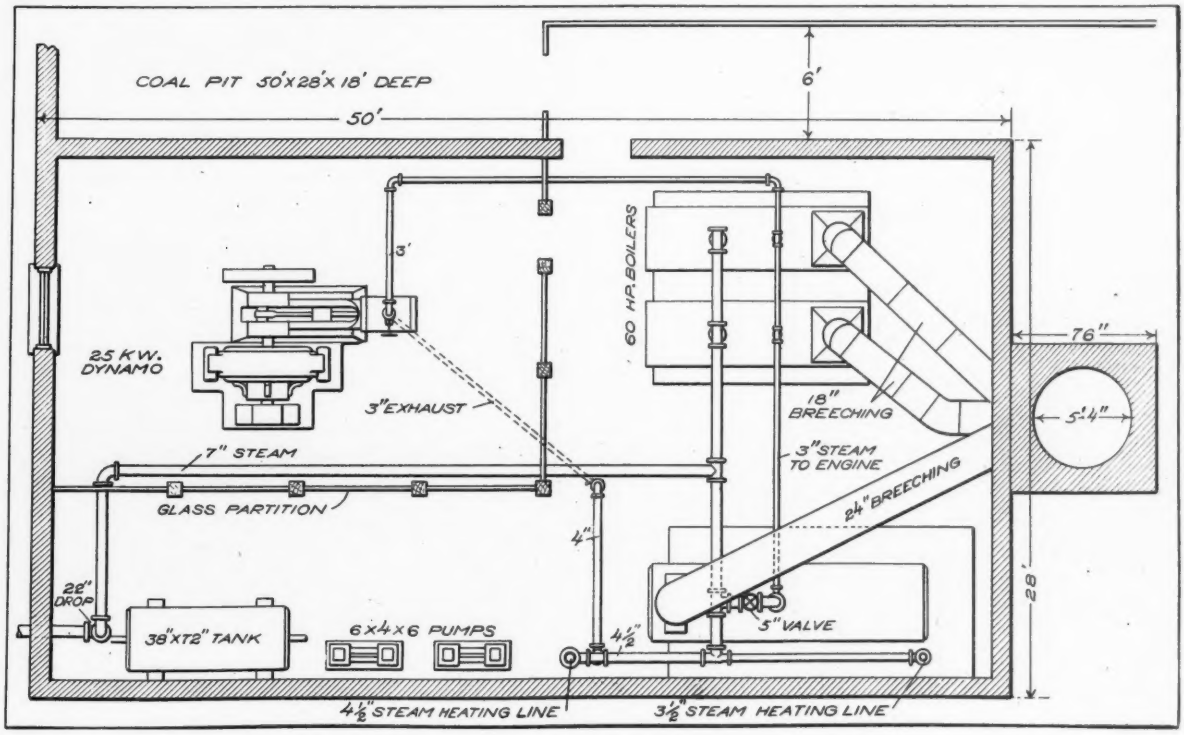


FIG. 3. FIRST ARRANGEMENT OF MACHINERY IN THE PLANT

didn't know what to do with his steam, he had so much. The next day I fixed the other furnace, and we then had steam on the buildings when they needed it. They had been running a 60-hp. boiler and a 33- and clean engine room. Fig. 3 shows the old arrangement of the machinery.

We then moved the pumps over where they now stand and set the tank up on end to get it out of a

mud hole where it lay and also to give head on the pump piston so that the pump would not run away every time the water got hot. I now have feed water as hot as 212 to 218 deg. when I get 5 lb. pressure on the exhaust heater and tank.

I got along that way for 3 yr. and then was allowed 2 new 54 in. by 14 ft. return tubular boilers. I had the 2 Star boilers moved out through the east window and set up by the smoke stack where the ends show in Fig. 1. We punched 2 holes in the stack and connected them up to the breechings, ran the heating and engine steam pipes in through the window and thus heated and lighted the building for 10 weeks with a frame shanty over the boilers.

We then turned the 54 in. by 16 ft. boiler around and placed it on the opposite side of the room, connecting right up to stack and piping. We slid the 2 new boilers in through the other east windows, put up the breeching and made pipe connections, and I had 3 boilers again with 100 per cent better draft than before. It kept a fellow on the jump to run both ends, but we kept the students quite comfortable up until December 1.

The boilers are now arranged 3 in one setting or battery. They can be run on the engine or heating system, separately or together, and furnish steam for a three power tub and a 14 drawer dryer, also steam for boiling the clothes in the laundry and for cooking all vegetables, meats and coffee for 400 people. Steam is furnished to the heating system for 6000 sq. ft. of radiation with the farthest building 800 ft. from the plant, and power is also furnished for a 25-kw. electric plant. The combination system for the boiler plant is very satisfactory. We now have 5 buildings besides the laundry and do the work with ease, running 2 boilers. When the outside temperature is 20 deg. below zero and a strong northwest wind is blowing the buildings are warmer than they were before with the direct system, using 1/3 less coal. I formerly had to run 2 boilers, low pressure and one high.

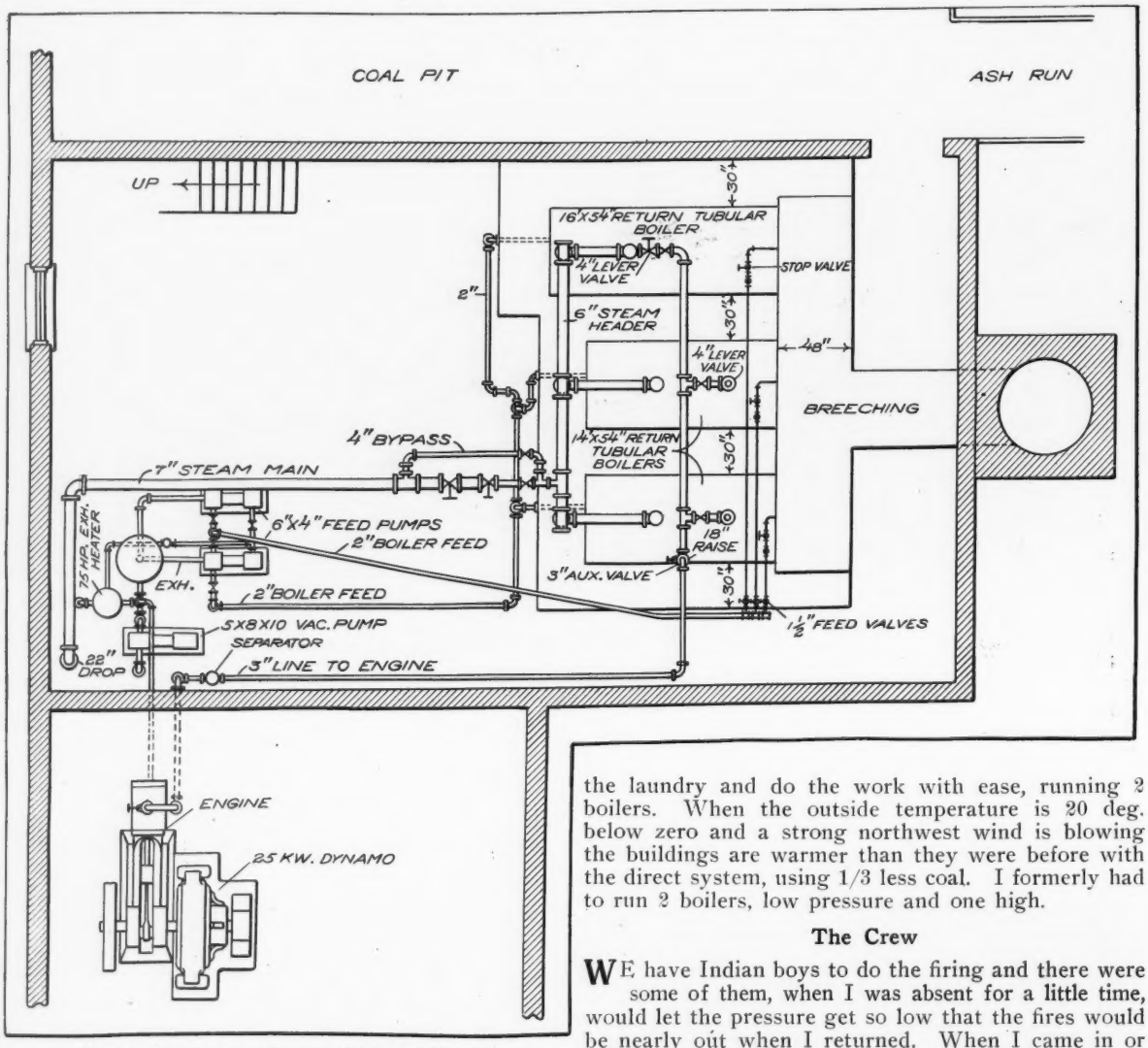


FIG. 4. THE PLANT AS REARRANGED

The Crew

WE have Indian boys to do the firing and there were some of them, when I was absent for a little time, would let the pressure get so low that the fires would be nearly out when I returned. When I came in or when they heard the assistant coming, they would shovel in about a wheel barrow load of coal to make believe that they were working hard. That bluff isn't any use now. We have 2 boilers under 60 to 80 lb. pressure and reduced on the heating system to 4 lb. with 5 in. vacuum on the end so that steam has to stay up or everything stops.

The Indian can learn to work if he wants to, but generally he will not unless you force him to. There are a small minority who are good workers, and I have had one or 2 boys each year who have taken hold and learned so that when leaving school they have done well, but as I have each year a bunch of

14 boys from 14 to 18 yr. old, turning out 2 who are skillful is not a very good showing. The greatest fault of these boys is that they don't want to stick to any one thing; they want to change from farm to carpenter shop, then to harness and to shoes, to tailor and laundry and kitchen, then to the power house and then back to the farm, and so by the time their term is out they know nothing thoroughly. The boy who stays in one place as the white boy would do, learns and is able to go out and earn a living, and he does it.

Figure 5 shows the re-arranged pumps, the tank for returns and the exhaust heater which I had put in the first thing upon taking charge, and Fig. 6 the engine, a corner of the switchboard, 2 arc lamps on the repair rack and some of the boys who work in the power plant.

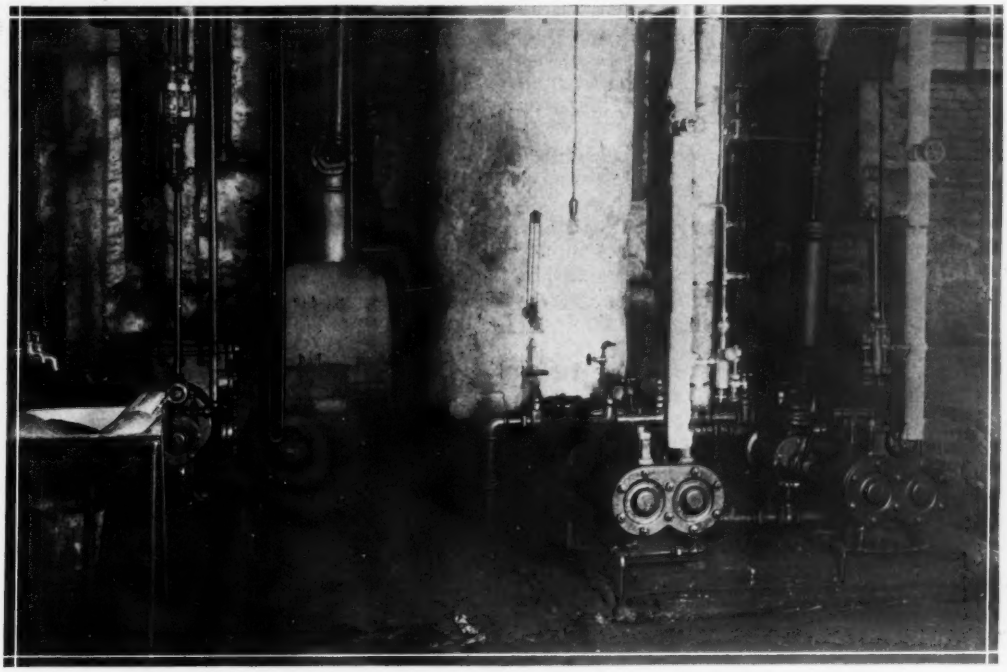


FIG. 5. PUMPS, RETURN TANK AND EXHAUST HEATER

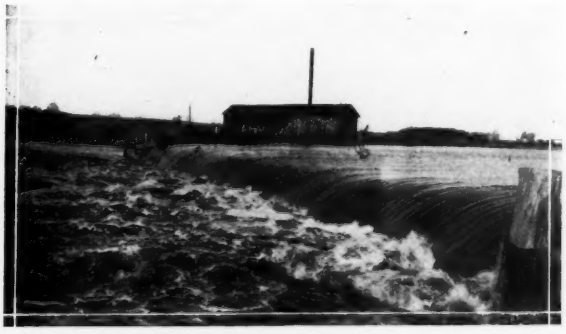


FIG. 7. PUMPING PLANT LOCATION AT THE MILL DAM

The pumping station is shown in Fig. 7. This is located at the bank of the river, some 3200 ft. down the hill from the main plant, and consists of one return tubular boiler, 12 ft. by 48 in., a Gardner pump for water service, a Worthington pump for boiler feed, and an altitude gage for the boy who runs the plant to go by.

In Fig. 8 is shown my own idea of how to heat the water in the return tank, also to fill the tank with hot water from the exhaust heater when the engine is in service nights so as to purify the water. Exhaust from the pumps goes through a coil, as shown, into the exhaust heater, where the cylinder oil is extracted by the oil trap. It then passes into the water in the return tank where it is condensed in heating the water in the tank. Tank and heater are connected to the blowoff of the boilers so that I can use either boiler as a tank, thus storing up water enough to run 24 hr. if necessary. The tank is connected to a rain water barrel on the boiler house roof, Fig. 1, which I find a great scale remover; effective in putting the scale in the ash pit, and cannot find that it causes any pitting in the iron of the boiler shell.

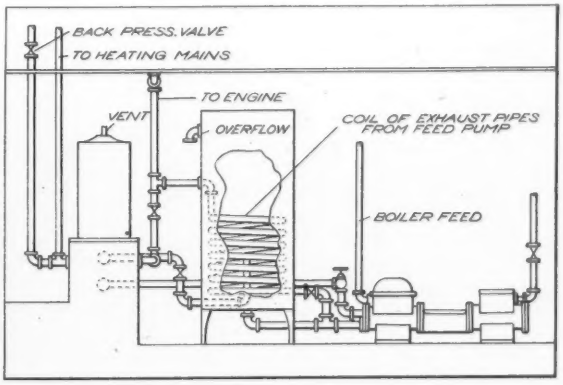
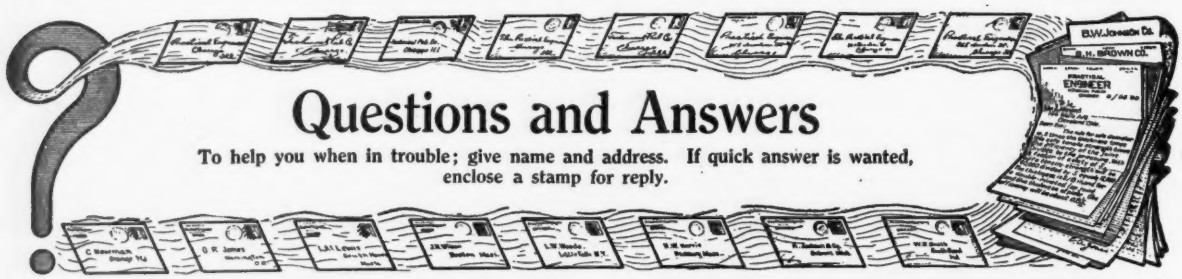


FIG. 8. HOME-DESIGNED WATER HEATING AND PURIFYING ARRANGEMENT



Questions and Answers

To help you when in trouble; give name and address. If quick answer is wanted, enclose a stamp for reply.

THE CHIEF ENGINEER'S CATECHISM VIII

WHAT do you consider the best furnace construction for burning oil under boilers?

2. In burning natural gas, what proportion of air to gas will give the best results?

3. How does producer gas compare in heat value and efficiency with natural gas?

4. What instrument is used in determining the percentage of moisture in steam and how does it operate?

5. Why should a feed-water heater be proportioned to the horsepower of the boiler?

6. What material would you recommend for the coils or the tubes in a closed heater?

7. What ratio of area would you use of water valves to plunger or piston? Of suction opening and of discharge openings to plunger area?

8. What area of steam outlet should be allowed for a boiler, and how determined?

9. At what point in a piping system would you place steam traps and why?

10. Where should a safety valve be placed and how connected?

(The best set of answers to these questions will be paid for at the regular rate, and the author of the second best will receive a prize of $3. Answers will be published in the February 1 issue, and all answers should reach Practical Engineer not later than January 1.—Editor.)

Pump for Returns

WE are now using the exhaust steam to heat our dry kiln, factory, warehouse and office, but find we must carry excessive back pressure on the engines, because of the large amount of pipes through which the exhaust steam must pass. I have suggested to the firm that a pit be dug in the ground 6 or 8 ft. deep and large enough to contain a pump. Then pipe the returns from the dry kiln, factory warehouse and office into one common return, which will be the suction pipe of the pump.

The object of the pit in the ground is to allow the returns to flow into the pump by gravity. I am of the opinion that a partial vacuum will be maintained in the heating system and greatly assist the engine to overcome the back pressure.

Forty horsepower is the capacity of the engine, and there will be 134 linear ft. of 3-in. pipe and 2248 linear ft. of 1-in. pipe through which the exhaust steam must be forced by the engine or drawn by the proposed pump. The water of condensation is then to be forced into an open tank about 20 ft. above the pump, from which the regular boiler feed pump will force the water back into the boiler.

I would appreciate comments on the proposed change and wish you would advise me if the plan will be practical; if so, what kind of a pump and how large should the pump be? A. C. G.

ANSWERS TO THE CHIEF ENGINEER'S CATECHISM VI

By Fred L. Wagner

COMBUSTIBLE is a substance that will take fire and burn; it is used, therefore, to denote that part of coal that will burn.

The parts of the coal driven off by heat are called the volatile substances, while the parts remaining form coke which is the fixed carbon. Volatile substances are 2 classes, combustible such as hydrocarbons (hydrogen and carbon), and noncombustibles, such as water, free oxygen and nitrogen.

2. Natural draft is better suited than forced to high efficiency combustion. In recent years the use of forced draft has become more common in plants. Its adoption does not insure an economy of fuel or the promotion of high efficiency combustion, because of the danger of an excess of air supply, which lowers the efficiency of the furnace; but it does help to increase the capacity of a boiler of given size.

3. I prefer the pressure system of feeding oil to boilers because it insures a more steady and continuous supply to the nozzles and lessens the possibility of the burners becoming clogged with any foreign matter which may often come with the oil.

4. The average number of cubic feet of natural gas required per hour for a boiler horsepower is 42 for water-tube boilers and 50 for flue boilers.

5. Where the conditions in reference to the coal supply warrant or compel the use of anthracite of large steam sizes, the boiler may be set a comparatively small distance above the grates; in some cases, as low as 18 in.

Where the conditions warrant the use of soft coal and especially that of high percentage of volatile matter and moisture, the boiler must be set much higher above the grates to give ample space for complete combustion to take place.

6. The combustion chamber of a boiler is used for 2 purposes: First, to provide a place for the small particles of ash and coal dust, which are carried over the bridge wall by the draft, to accumulate; second, to provide a chamber of high temperature in which the unburned gases from the firebox or furnace may be thoroughly mixed with a proper amount of oxygen to insure their complete combustion before entering the stack.

I prefer to have a deep combustion chamber of sufficient volume to provide a place in which the gases may be burned and give out their heat before coming in direct contact with the comparatively cool boiler tubes and plates.

7. The same furnace, stack and draft cannot be used economically with all bituminous coals. Coal very rich in volatile substances requires a much higher furnace to facilitate good combustion. With the larger grades of coal, such as lump and block, it is not necessary to have a very high stack to produce draft

enough to draw the proper amount of air through the coal bed to attain good combustion. But with the smaller sizes, such as mine run and screenings, a much higher stack is needed to produce draft strong enough to draw the proper amount of air through the fine coal.

8. An absolutely pure feed water is not desirable for boilers, because pure water promotes corrosion and wasting away of the plates. Pure water, such as the return water from a heating system is injurious to boilers, owing to its corrosive tendencies, unless the boiler is protected by a very thin coat of scale.

9. Boiler scale as usually found is a hard, brittle deposit of thickness varying from 1/32 in. to as much as ½ in. in some extreme cases. When a boiler is opened for cleaning we invariably find 2 deposits, one, which is removed easily and is composed of sediment, mud, clay, etc., the other hard and more difficult to remove. The following is a typical analysis: Sulphate of lime, 62.86; magnesia, 18.95; silica, 2.60; peroxide of iron, 0.92; water, 1.38; carbonate of lime, 12.62 per cent.

10. A good feed-water heater which will heat the water to 212 deg. will remove or cause 90 per cent of the carbonates in the water to be precipitated within the heater. But the effect of this good feature is lost in most cases by allowing the temperature of the water to drop and having the heater too small for the amount of water required in the boilers, so that carbonates do not settle but are carried into the boiler.

By F. O. Wells

1. The term "combustible" is used to define the inflammable substances found in different kinds of fuel. These substances intermixing rapidly with oxygen burst into flame, and thereby cause combustion. It is generally used to define comparative evaporative tests of boilers using different qualities of fuel. The comparison being made on the amount of water evaporated per pound of combustible.

2. Natural draft gives a good supply of air to the fire under ordinary conditions, but when enormously high rates of combustion are to be obtained and kept up, forced draft is the more efficient.

3. I prefer the pressure system of feeding oil, as it insures a steady supply of oil to the burner, and facilitates the intermixture of the air and oil, thereby causing a better combustion.

4. Under general conditions 30 lb. of water are evaporated for one boiler horsepower. Haswell gives an evaporation of 0.68 lb. of water per cubic foot of gas. Then the number of cubic feet of gas needed to evaporate a boiler horsepower, would be the number of times 0.68 is contained into 30, which would be 45.5 cu. ft.

5. Boilers should be set low above the grate bars when using anthracite coal, and high above the grate bars when using bituminous coal. Bituminous coal, being high in volatile matter needs a large space for the intermixture of the combustible gases with the air, while anthracite, being low in volatile matter and high in fixed carbon, can use a much smaller space for combustion. Bituminous coal will not burn well except in a thick bed and at high temperature, and when removed from the chilling influence of adjacent cold iron. A hot fire and large space for combustion are here essential. The furnace may, therefore, be of less capacity with hard than with soft coals; but a good height over the grate and a large combustion chamber are very desirable with the latter, and are an advantage in all cases.

6. The "combustion chamber," which usually forms part of a well-designed furnace, may be either simply an enlargement of the height of the furnace itself to obtain the space and time necessary for the gas currents to complete intermixture and thorough combustion, or it may be any separate chamber beyond the grate. The latter is often the better method of securing the desired results; but the more usual plan is that giving considerable height to furnace crown. A large combustion chamber should, when possible, be provided, and more complete combustion may be expected in furnaces of large size, lined with fire brick, and with arches of the same material, than in a furnace of small size when the fire is surrounded by chilling surfaces.

7. The furnace, stack and draft should work well for all grades of bituminous coal under general working conditions, but if it were desired to burn "slack or breeze" more air spaces of smaller area in the grate bars, and a stronger draft would be needed.

9. Scale is deposited in boilers by the precipitation of mineral or other salts previously held in solution in the feed water, or by the deposition of mineral insoluble matters, usually earths, carried into it in suspension or mechanical admixture. Occasionally also vegetable matter of a glutinous nature is held in solution in the feed water, and, precipitated by heat or concentration. These impurities are generally either calcium carbonates or calcium sulphates, or a mixture; the first is more common on land, and the second at sea. Organic matters often harden these mineral scales, and make them more difficult of removal. A water carrying a considerable amount of carbonate of lime and other alkalies in solution, and used in boilers of locomotives in the Mississippi valley, deposited a scale having the following analysis: Iron peroxide, 5.7 per cent; silica, 2.96 per cent; potassa, 5.131 per cent; alumina, 0.32 per cent; soda, 2.137 per cent; sulphuric acid, 0.006 per cent; lime, 24.76 per cent; magnesia, 3.294 per cent; carbonic acid, 41.06 per cent. This may be taken as a fair sample of the scale to be found in limestone districts.

By T. E. Medaris

3. I prefer the gravity feed for oil to boilers. Place the oil tank or tanks under ground with a supply line, place another small tank for the supply on top of a tower or the building, then by the aid of a pump keep the supply tank about 4/5 full. This can be done by the aid of a float in the tank and a valve in the steam line of the pump; then the oil will feed to the boiler furnace by gravity through a feed line of which the fireman can regulate the gravity by a gate or globe valve in the line to any desired amount he should need, then by the aid of air or steam jet, the fire is ready and no danger of pipes bursting. In case of pressure the pipes are liable to burst and give no end of trouble; in this case the plant is in danger of burning, causing death and destruction.

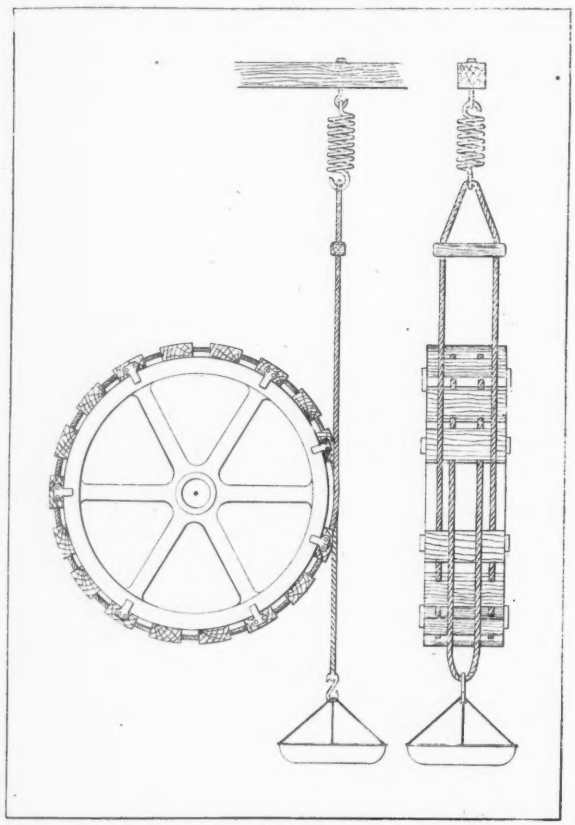
5. In case of hand firing and natural draft, set the boiler low. The fireman can carry a lighter fire than in stoker firing and the boiler will receive more heat from the bed of fire than when the boiler is high and in firing little and often, on opening the fire doors in firing the boiler will not cool down as it would if high. In stoker firing and forced or induced draft where the doors are not open and a cheaper grade of coal is burned where a heavier fire is necessary and more oxygen to complete the combustion, set it high

10. A good feed-water heater should remove 80 to 90 per cent of carbonate, the throwing down of carbonates occurs at 200 deg. F. and over. Most of the sulphates are disposed of by adding carbonate of soda to the water, grain for grain. The carbonates are thrown down by heating the water. Hence the carbon dioxide is driven off and the water has not the power to hold carbonates in solution.

Brake to Test Auto-Truck Engines

I HAVE some 4-cylinder auto-truck engines to test and would be pleased to have you give me some information as to the best method to use. They are 35 to 40-hp. and must run a 10-hr. test, and I must be able to tell what horsepower they are devoloping at all times. C. F. B.

A. The best method of testing these is by the means of the prony brake. In fact it is the only accurate method of getting the developed horsepower. You could, of course, arrange to put on an indicator



SIDE AND END VIEW OF PRONY BRAKE ON WHEEL

and measure the indicated horsepower in that way, but even then you would have to have some means of loading, and it is as easy to measure the power from the brake as by any other means.

The simplest form of brake to use is a series of blocks of soft wood attached to a couple of ropes and spaced around the rim of the flywheel. The ends of the rope are passed across each other, one end carried up to a spring balance and the other carried down to a scale pan which can be loaded with known weights as necessary; the weight of the scale pan must, of course, be known. The more weight is put on the scale pan the greater will be the load carried by the engine. The weight must, of course, be sufficient so that the friction of the flywheel against the blocks will not carry the weights around the wheel.

If there is no flywheel on your engine, it would be necessary to get a wheel which could be attached to the shaft during the test. In order to avoid overheating the surface of the wheel, it will be necessary to keep a stream of water playing on it during the test, preferably dropping this on the top of the wheel and letting it run down the sides to a pan and drain away. A strip of sheet iron may be put around the wheel to prevent throwing of water.

To compute the horsepower, the radius in feet from the center of the engine shaft to the center of the rope is multiplied by 44/7 and by the revolutions per minute of the engine and by the difference between the register of the spring balance and the weight at the scale pan end of the rope. This includes the weight plus the weight of the pan. This continued product is divided by 33,000 and the quotient gives the horsepower developed at the flywheel.

Size Angle Iron

WE would like to know the size steel angle iron that would compare in strength for trussing purposes to 1¼-in. and 1-in. wrought iron pipe respectively. The load to be carried by one leg of the angle, the other leg would need only be wide enough to eliminate buckling. C. W. Z.

A. Presuming that the 1¼-in. or 1-in. pipe used for trussing will be so arranged as to take a tensile strain entirely, the angle iron to equal it would be one of simply the same cross sectional area of metal. The metal area of a 1-in. pipe is 0.495 sq. in., which would be practically a 2 by 1¼ in. angle, ¼-in. thick, or a 2¼ by 1½, 3/16 in. thick. For 1¼-in. pipe the metal area is 0.668 and the equivalent angle would be 2 by 1¼, 5/16 thick, or 2¼ by 1½, ¼-in. thick.

Air Compressor Lubrication

IN an article on lubrication air compressors, by Mr. Boycott, in the September number, a paragraph reads thus: "On no account must an engineer in charge of an air compressor introduce light oil through the inlet pipe for the purpose of cleaning out valves or extra lubrication. Under such circumstances the conditions for an explosion are ideal, as the oil will be drawn in, in the form of spray and atomized."

I cannot see where it makes any difference whether the oil is admitted through the inlet pipe or through the oil cup, as the oil from the cup enters the inlet side, and the oil will be atomized either place.

Am I correct in my opinion? H. C.

A. Mr. Boycott's article in the September issue of Practical Engineer, on "Lubrication of Air Compressors," contains several statements that are at variance with my experience with that type of machine—an experience that covers a period of 15 years and includes the investigation of 14 explosions of air compressors and their connections. The quotation given is one.

When oil is admitted through the sight-feed lubricator, it enters the cylinder during the "suction" stroke and so much of it as fails to adhere to the cylinder walls or valves, finds its way to the receiver and the oil takes exactly the same course when admitted through the air inlet. It is very doubtful whether the oil becomes atomized to any extent during its journey through the cylinders, and when the compressor is operating properly, even the lightest of lubricating oils will not vaporize when subjected to a

pressure of 45 lb. to the square inch, and should all the oil that could adhere to cylinder walls and the pipe leading to receiver become vaporized and ignited, it would not cause an explosion.

Mr. Boycott says: "As an actual matter of fact, oil having a flash point of 412 deg. F. has been found to vaporize when compressed to 38 lb. to the sq. in." If oil of that flash vaporized in a compressor filled with air at a pressure of 38 lb. to the sq. in., it would be proof positive that the air was heated (probably by churning) to a much higher temperature than that due to the compression of air from a temperature of 100 deg. F. and the pressure of the atmosphere, for the reason that the flash test of the oil was taken in a vessel open to the atmosphere, and oil flashing at a temperature of 412 deg. F., when not under pressure, would not flash at a temperature of less than 550 deg. F. when under a pressure of 38 lb. to the sq. in.

Mr. Boycott also says: "A remedy was found by using oil having a flash test of 700 deg. F." He has evidently taken some one's word to the effect that the oil had a flashing point of 700 deg. F., for the truth of the matter is that there is not a mineral oil on the market with a flashing point so high, and if there was, it would be so viscous that it would not flow and would necessarily contain so much carbon as to render it unfit for the lubrication of air compressors.

Charles H. Garlick.

Splicing Rope; Testing Armature

I SHOULD like some information on splicing a 3-strand Manila rope.

What is a good method of armature testing?

C. D.

A. You will find the proper method of rope splicing in the January, 1911, issue of Practical Engineer. Although it deals with the 4-strand splices, you should have no trouble in splicing a 3-strand rope by this method for the operations of measuring back, tying,

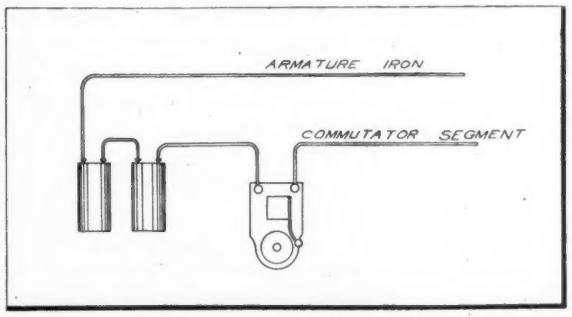


FIG. 1. TEST FOR GROUND

unraveling and butting together is the same as in a 4-strand. There is one pair of strands less, and you lay out one pair of strands in each direction, leaving a tucking end. One pair of strands remain in the center. Every other operation is the same as a 4-strand rope.

The test for grounds is made by simply connecting one pole of a bell circuit to the iron of the armature, the other end to any commutator segment.(Fig. 1.) If there is a ground the bell will ring. The ordinary lighting circuit may be used, in which case an incandescent lamp replaces the bell. The lamp will light up in case of a ground.

An open circuit may be located by the method shown in Fig. 2. The leads of a voltmeter are connected to adjacent commutator segments; current regulated by the resistance R is then applied through the 2 brushes at top and bottom, until voltmeter shows an appreciable deflection.

Looking now at Fig. 3, which illustrates an armature winding, suppose the break to be at A; current enters through the brushes B1, B2. Suppose the voltmeter leads had been applied at Y-Z until it registered a drop of say 3 volts. If the leads are now moved to any consecutive pair of segments on that side of the

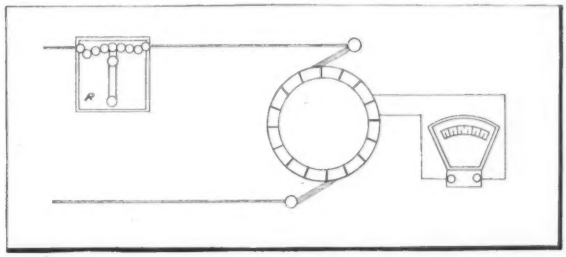


FIG. 2. TEST FOR OPEN CIRCUIT IN ARMATURE

brushes, the reading will be practically the same, for in each case the coils are alike and form a shunt around the instrument. Now move the leads to the other side of the brushes across the segments M-N. By tracing out the circuit we see that no current can flow on this side because of the break at A; therefore, there will be O reading on the meter. By moving the leads across every pair of segments, all readings will be zero until they come to the break or R-S. Here the read-

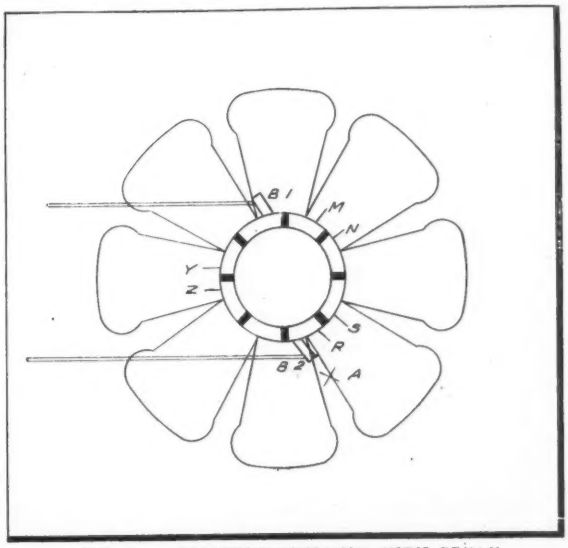


FIG. 3. ARMATURE WINDING WITH BREAK

ing will be very high, full voltage across the mains being registered minus the amount taken up by the resistance in the coils between R and the brush B1.

When testing for a short, proceed in the same manner, but instead of an increased reading across the voltmeter we shall have a diminished or no reading at all.

Another method is to connect a battery circuit to the brushes, having a switch or key in the line to open and close the circuit. Proceed around the segment with 2 leads from a telephone receiver in the same manner as with the voltmeter leads, opening and closing the circuit each time. When an open coil is encountered a louder click than across good coils will be heard. Across a short, the click will be less audible or not heard at all.

PRACTICAL ENGINEER

PUBLISHED ON THE FIRST OF EACH MONTH

At 537 Dearborn Street, Chicago, Ill., by the TECHNICAL PUBLISHING CO.

New York, 150 Nassau St. Philadelphia, 524 Walnut St.

Subscription Price One Dollar a year in advance to any Post Office in the United States and Mexico or United States possessions.

To Canada One Dollar and Fifty Cents; to Other Countries Two Dollars a year. Single copies 10 cents.

Address all letters and make all checks and money orders payable to Technical Publishing Co., 537 S. Dearborn St., Chicago, Ill. Notify us at once of any change of address, giving the old and the new address, so that your paper may always reach you promptly.

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Entered as second class matter May 1, 1908, at the Post Office at Chicago, Illinois, under the Act of March 3, 1879.

Circulation of this issue, 22,500.

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THE SIMPLIFIED TURBINE

At the meeting of the National Electric Light Association, last spring, Nickola Tesla announced for the first time tests on an improved and simplified form of turbine prime mover which, from the success so far achieved and from the probabilities, seems to embody a long step forward in the utilization of the energy of steam. Two difficulties have handicapped the turbine, the complication in reversing, and the great number of small parts which must be assembled to make the complete machine. Effort has been expended on all classes of prime movers to secure simplicity, gradual abstraction of the energy of heat and high speed in order to reduce waste. If the development of the future bears out the present promise, the new form devised by Tesla will go far to remove all these difficulties, and secure desirabilities.

To give an idea of what he has accomplished, a small turbine having a rotating member 9¾ in. in diameter and 2 in. wide, developed 110 hp. with free exhaust, and it had no blades, vanes, valves or sliding contacts of any kind, except the journal bearings. Furthermore, to reverse the direction of rotation, all that is necessary is to close one valve and open another. This power was developed when exhausting to the atmosphere and taking steam at 125 lb., and another unit on which rather extended tests have been made, and which had a rotor 18 in. in diameter by 3½ in. wide, running under like conditions of pressure and exhaust has developed 200 hp. at a steam consumption of 38 lb. per horsepower hour. While this does not seem a very remarkable steam economy, it must be remembered that this is a first experimental engine, that the turbine form of prime mover does not operate with the best economy unless the exhaust is at low vacuum, and that the weight of engine per horsepower developed was only 2 lb. The space occupied by this 200-hp. unit is only 2 ft. by 3 ft. and 2 ft. high.

At first thought it might seem that the speed used, 9000 r.p.m., would be a drawback, but here again it must be remembered that the rotating member consists only of thin steel disks fastened firmly to the shaft, and having no blades, vanes, or other loose or attached parts, and that even at the highest speed the tensile strain is not over 50,000 lb. per sq. in. on any part of the machine.

Tesla predicts that with a low-pressure stage added, exhausting into a 28½ or 29-in. vacuum, as is the case in steam turbine practice, he will secure a steam consumption of less than 12 lb. per horsepower hour on a 200-hp. unit, and that he will be able to get 10 hp. per pound weight of prime mover.

In accomplishing this result, Tesla has made use of a new principle in steam engineering, namely, the viscosity and adhesion of the fluid.

Heretofore, in abstracting the energy from steam, the reaction of steam to push the moving part forward has always been utilized. In the Tesla tur-

bine the steam drags the rotating member around with it by means of the adhesion of the steam to surfaces of the thin disks.

A somewhat similar process in the reverse direction has been utilized in the water brake for testing turbines in which disks are revolved rapidly in a chamber filled with water and the drag of the water on the disks produces a braking effect which loads the turbine. In that application, however, the disks are kept at some considerable distance apart and usually blades are introduced between them to retard the water so that the friction of the disk on the water is depended on to produce the drag.

It is easy to conceive that by placing the blades close together the water which will be caught between them would be thrown out as in the case of a centrifugal pump, and if there were an inlet at the center, a centrifugal pumping action would be produced. This is exactly what Tesla has done in the pump application of his principle; and the motor application is simply a reversal forcing the steam in at the edge of the disks in a tangential direction and permitting it to work its way inward in a spiral path until it exhausts at the center of the disk.

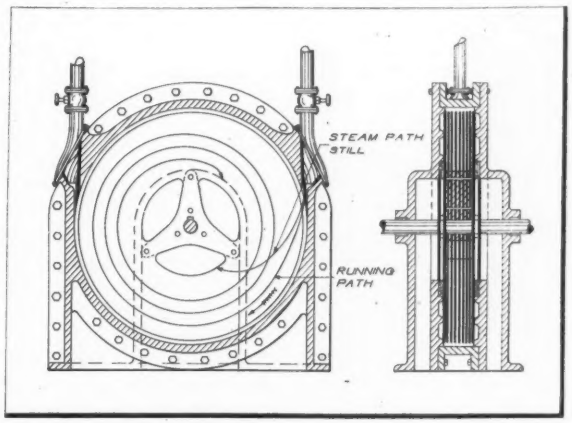
In the 200-hp. unit there are 25 disks, each 1/32 in. thick and so placed on the shaft that the entire distance occupied along the shaft is 3½ in. As there are no guide plates or vanes, the steam takes its natural path from the circumference to the center, and when the rotor is at rest, it flows by a short-curved path, as indicated by the line in the end view, across the face of the disk. When the rotor is up to speed, the steam, in making its passage across the face of the disk, makes several revolutions so that its path is from 12 to 16 ft. in the form of a spiral as indicated.

It is evident that as the direction of rotation of the shaft is determined entirely by the direction of the entering jet, all that is necessary to reverse the flow and the rotation is to shut off the nozzle at one side of the disk and turn on the nozzle at the other side. The drawing, which is an illustration of the patent principle, shows how this is accomplished, but does not, of course, indicate the actual detail of the working machine.

To show the reversibity of the operation as prime mover or pump, 2 200-hp. machines are coupled together through a torsion spring, and one of these is driven as a turbine while the other one has steam admitted in the direction opposite to that of rotation, and is used as a brake. Evidently the amount of twist of the torsion spring is an indication of the load carried and this has been used to construct a direct reading horsepower indicator which shows at a glance just what power is being developed.

Mr. Tesla, in an interview given to the Electrical Review, has stated that the 110-hp. turbine has attained a performance of more than 2 hp. per pound of material, and by careful construction for lightness might have been much improved, also that the steam consumption for this little unit was only 36 lb. per horsepower hour with free exhaust and back pressure of 1 to 2 lb. He states further that this economy could further be greatly increased by using a 2-stage machine, so that it would not take over 12 lb. per horsepower hour, which will be recognized as a remarkable performance for a 110-hp. prime mover.

To demonstrate the efficiency of the principle as a pump, Tesla has in his offices a 1/12-hp. electric motor driving a Tesla pump, which pumps 40 gal. a minute against a 9-ft. head. Evidently the motor is carrying some overload as the water horsepower would be 0.09 while the rated capacity of the motor is 0.083 hp., but the demonstration serves to show the high efficiency of the principle when applied to pumping.



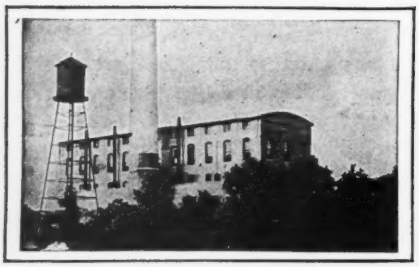
SECTIONAL VIEWS OF THE SIMPLIFIED TURBINE

It is evident that so simple a device, and one which has in it the elements of high efficiency, has wide application in the industries, and, the simplicity of construction and the strength that may be secured, make it seem probable that a solution of the gas turbine proposition is to be worked out along this line. It is quite conceivable that by applying this method the simplicity of the steam turbine and the high efficiency of the gas engine will be combined, giving us a more efficient heat motor than has yet been known. Much remains to be determined as to distance between disks, diameters and speed of revolution for different pressures, but the workability of the principle seems to be proved.

AT A MEETING of the Executive Committee of the Master Boiler Maker's Association, held at the Fort Pitt Hotel in Pittsburgh, Saturday, Oct. 28, it was unanimously decided to hold the Sixth Annual Convention of this association in Pittsburgh, May 14 to 17, inclusive, 1912, headquarters being at the Fort Pitt Hotel.

George N. Riley, of the Nation Tube Co., was made chairman of the general committee of arrangements and J. Rogers Flannery, of the Flannery Bolt Co., secretary and treasurer of such committee.

"LET WELL ALONE" is a foe to progress, "Do it better" is the friend of the future.



Power Apparatus

In Shop and Market

New Ideas in Making, Buying and Selling

NEW DEPARTURE IN ENGINE LUBRICATING

PRACTICALLY all engineers now realize the economy in oil and steam due to the use of an efficient lubricating system on their engines and auxiliaries. Systems of the central type, in which oil is supplied from a central source and passed through pipes to all of the bearings on the different power units and their auxiliaries, and with the drips from the bearings collected and returned to a large central filtering plant and after impurities are removed the oil recirculated, are not so well adapted to the ordinary, small, isolated plant, because they are too expensive and a large amount of piping is required.

In order that small plants may have the benefit of scientific lubrication, the Richardson-Phenix Co. has designed and is now manufacturing an individual oiling system. The advantage of this system is that all of the various pipes, receivers, filters, pumps, etc., can be located on or close to the engine.

To make it easier for the engineer to equip his engines with automatic lubrication, the company has now further perfected the individual automatic oiling

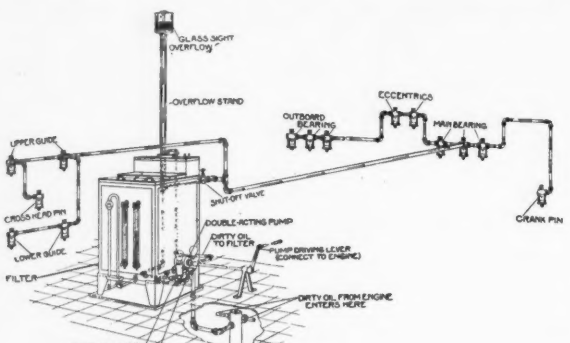


FIG. 1. RICHARDSON OILING AND FILTERING SYSTEM FOR AN ENGINE WITH 14 POINTS TO BE LUBRICATED

system, so that it needs know only the horsepower of the engine, the type and make, and it can supply a system complete with all the necessary appurtenances, which can be readily attached to the engine.

Two standard systems are now being built, the one shown in Fig. 1 is known as the Richardson System, and that in Fig. 2 as the Phenix System.

The Richardson System is more desirable for large Corliss engines, and is furnished in units for lubricating engines of 100 to 1500 hp., and in sizes having an oil filtering capacity of from 4 to 35 gal. an hour. The Phenix System is built for engines of from 10 to 200 hp. and in sizes having a filtering capacity of from 1 to 4 gal. an hour.

While the essential parts of these 2 systems are identical, they differ somewhat in detail. Briefly, their operation is as follows: Used oil from the various points of lubrication is collected into a suitable receptacle located at some point so that the oil flows into it by gravity; then a pump elevates the dirty oil to the top of the filter. After having all impurities and entrained water removed in the filter, the oil either flows by gravity or is forced by a pump to the various points of lubrication.

At each point of lubrication a sight feed oiler is provided, by means of which the amount of oil fed to that bearing can be accurately adjusted independent of the amount of oil supplied to all of the other bear-

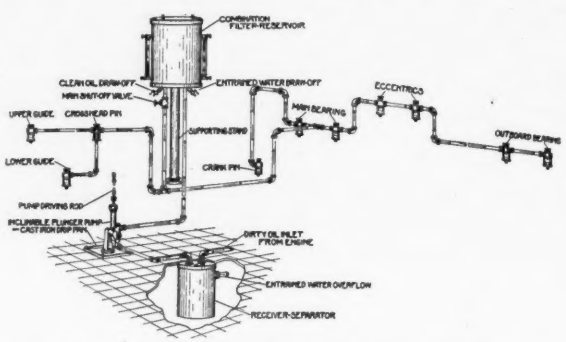


FIG. 2. DIAGRAM OF PHENIX INDIVIDUAL OILING AND FILTERING SYSTEM

ings. The gage glass in each feed enables the attendant to see exactly how much oil is being fed.

These individual systems are designed as a unit, that is all parts fit together and operate satisfactorily. The filter and pump have the right capacity for the number of feeds and the proper amount of piping is supplied for each type of engine. In connecting up the Richardson-Phenix Systems, all troublesome pipe fitting is eliminated by the use of novel devices known as Union Cinch Fittings.

It is claimed that these systems will reduce the steam consumption of engines by 2 to 20 per cent over that necesary when the old fashioned hand oiling method is relied upon. It has been figured out that in any size engine a reduction of 2 per cent in the steam consumption, due to the reduction of power consuming friction, will pay for necessary oiling systems in the amount of steam saved alone inside of one year. It is also claimed that these systems will reduce the oil consumption anywhere from 40 to 75 per cent. Both new type systems are made by the Richardson-Phenix Co. at Milwaukee, Wis.

A LIVE WIRE is sure to burn the man who handles it without knowledge and good reason. Are you a live wire?

THE "DIAMOND" SWINGING ARM BLOWER AND JET BLOWER WITH POINTER AND DIAL

SPECIAL precaution has been taken by the "Diamond" Power Specialty Co. of Detroit, Mich., against all possibility of heat affecting their new type of swinging arm blower, as illustrated herewith.

It will be noted that the general design of this blower is a pipe within a pipe, with a heavy layer of insulation between. This insulating material is for the purpose of preventing any heat reaching the inner pipe. The outer pipe is altogether for the purpose of holding this insulation in place, and even though this should in time corrode and pit through, it will still bind

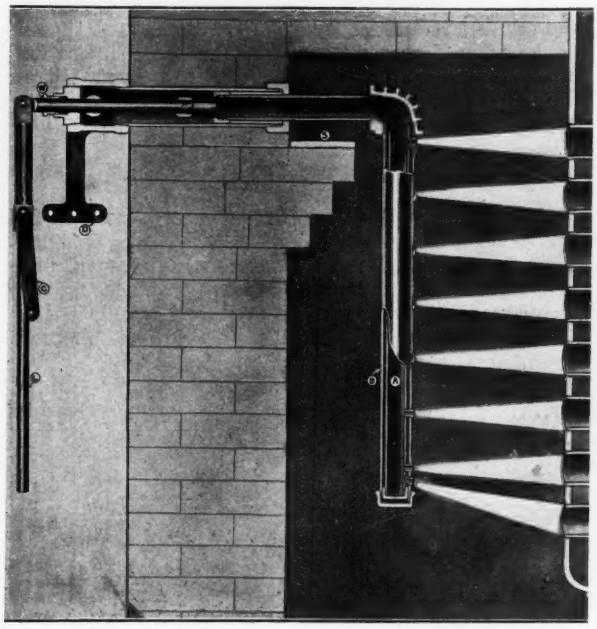


FIG. 1. NEW "DIAMOND" SWING ARM SOOT BLOWER

the asbestos lining, which is its only purpose. This insures to the blower a life and service equal to the boiler itself.

Another important feature is the shelf upon which the arm is withdrawn, and rested when not in use, thus placing it out of the direct path of the heat and flames.

This blower is designed only for boilers having a flat arch and in such conditions, meets every possible requirement.

In the design of the "Diamond" Single Jet Blower with pointer and dial, an entirely original principle has been put into practice.

It will be noted from the illustration that a dial is provided, into which are cut 6 notches. Placing the dial indicator on the first notch so changes the angle of the jet that the steam is directed into the outside flues. Swinging it around to the last notch changes the direction of the steam so that it shoots directly into the central tubes. The pointer changes with the dial indicator and in this way the operator is in complete control of the operation at all times, and can direct the steam into any portion desired and omit it from other portions that should not be touched.

Another feature of this blower is the fact that the nozzle recedes into the shell about 6 in. when not in use, thus fully protecting it from the direct action of the heat and fumes and giving it durability.

This blower is the design of the "Diamond" Power Specialty Co., of Detroit, Mich.

MEANS FOR DETERMINING FLUE GAS TEMPERATURES

AT the basis of all scientific management are quantitative measurements, and one of the most notable developments in modern steam plant practice is the introduction of all kinds of meters for weighing the coal, measuring the boiler feed water, determining the flow of steam, sampling the gases of combustion, recording the temperature of the water entering the boiler, measuring and recording the draft in the ashpit and in the chimney and measuring the many other quantities that enable a steam plant engineer to compare his plant intelligently with other

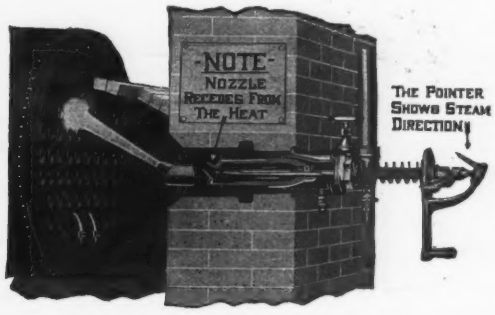


FIG. 2. "DIAMOND" JET BLOWER WITH POINTER AND DIAL

plants of the same class and to determine the magnitude of losses and the possibilities of improvement.

In the operation of a steam boiler, one of the most important quantities is the temperature of the gases passing to the chimney, since, other things being equivalent, this temperature is a direct measure of the portion of the heat of the fuel which is wasted or not utilized. If we assume a pound of coal having a heating value of 14,000 B.t.u. to be burned with 20 lb. of air, which is about the smallest ratio of air to coal found in actual commercial practice, the temperature in the furnace after complete combustion should be about 2500 deg. F. above the temperature of the atmosphere.

The temperature of steam at 150 lb. gage pressure is 366 deg. F., and if it were possible to transfer all of the heat in the gases above this temperature (and it is impossible to transfer any below this temperature) to the steam and water in the boiler, the efficiency of the boiler would be 88 per cent; that is, the boiler would recover all but 12 per cent of the heat of the coal.

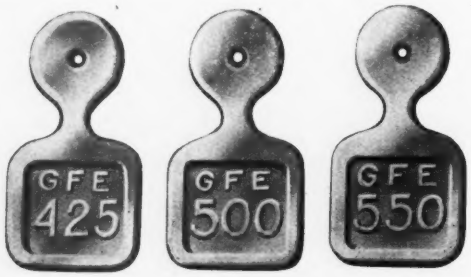
As a matter of fact, no boiler reduces the temperature of the gases to the temperature of the steam, for as the temperature of the gases approaches that of the contents of the boiler, the rate of heat transmission per square ft. of boiler surface per hour falls lower and lower. There is, therefore, a limit to the amount of boiler surface that it pays to put in.

Commercial practice some years ago established this limit of surface at about 10 sq. ft. of boiler sur-

face per boiler horsepower, but recent practice has shown that a boiler horsepower can be produced on from 3 to 5 sq. ft., or even less, and in some plants it has become a matter of routine to drive the boilers at about 60 per cent above the nominal rating of 10 sq. ft. per boiler horsepower.

Even disregarding the number of square feet of boiler heating surface employed to produce a boiler horsepower, it is found in commercial plants that the chimney gases escape at temperatures considerably above the steam temperature, as at 450 to 500 deg. at least, which represents a waste of from 20 to 40 per cent of the heat of the coal.

The usual and most practicable way of recovering waste heat from chimney flue gases is by means of the economizer, the heating surface of which, because



GREEN'S TEMPERATURE PENDANTS

of the lower temperature of the contents, is much more active in absorbing heat than an equal amount of surface in the last pass of the boiler. That is, since the economizer receives water at a temperature of 80 to 150 deg. and discharges the water at 200 to 300 deg., with an average temperature for the whole economizer of around 200 to 220 deg F., it is able to absorb about twice as much heat from gases at 500 deg. F. as can the boiler surface.

Obviously the advisability of putting in economizers or of making other changes in the equipment depends to a large extent upon the actual temperature of the gases as they leave the boilers. The temperature of the flue gases is an essential factor in checking the proper operation of the furnaces, tightness of the setting and other factors, as well as for calculating the heat available for recovery.

There is, therefore, a demand for cheap and efficient means of determining flue-gas temperature, which the Green Fuel Economizer Co., of Matteawan, N. Y., has met by devising the temperature pendants shown herewith. These pendants consist, as may be surmised, of fusible alloys of the proper composition to indicate the desired temperatures.

It is an interesting fact that the melting points of such metals were found to be too uncertain and evasive to be used as temperature tests. That is, it is difficult to tell the exact point at which the metal melts, since it does not change suddenly from a hard solid to a liquid, as does water, but goes through an intermediate softening stage similar to iron and many other substances. Even after the metal is completely melted, a hard skin of oxide is usually found to have been formed upon its surface, which prevents the metal running easily and therefore is apt to confuse the determination of the exact temperature.

The Green Fuel Economizer Co., therefore, devised the expedient of using the tensile strength of the metal, instead of the melting point, as the true indication of temperature. In other words, the pendants are made with a large body, having a certain definite weight, suspended from a narrow neck, and the composition of the metal and cross section of this neck are adjusted until, at some desired temperature, the body of the pendant will pull the neck in two and fall.

In actual use the pendants are hung upon a small hook made upon the end of a long wire, which is introduced into the flue so that the pendant will be at the desired point. The best way is to begin with the lowest temperature pendant and proceed until the one is found which will not fall off after 5 or 10 min. exposure. The temperature will then lie somewhere between the temperature marked on the last pendant and the next to the last pendant used. In doing this, it is quite essential that several different points in the flue be tried, as it frequently happens that one part of the flue is occupied by gases much hotter than the gases in other parts of the flue.

At present there are perfected pendants for 3 temperatures, i. e., 425, 500 and 550 deg. F.

The Green Fuel Economizer Co. advises us that it will be pleased to send samples of these temperature pendants to any one connected with a steam plant who would be interested in determining the temperature of chimney flue gases.

PIPE THREADING

EXPERIENCE of pipe manufacturers and others who do their threading by machinery, and use the improved form of die, shows that steel pipe can be threaded just as rapidly as iron, with less wear on the dies, and is preferred by the operator. The same may be said as to dies used in ordinary hand stocks.

To insure a good threaded joint between the pipe and fitting it is necessary to have a clean, smoothly

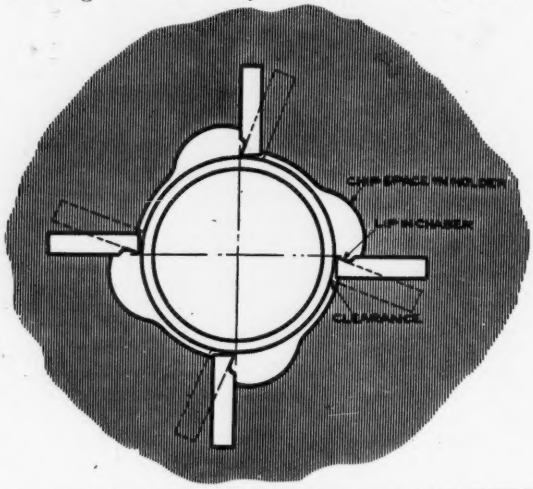


FIG. 1. SHOWING HOW REQUIREMENTS FOR GOOD CUTTING ARE MET BY A PROPER DIE AND CHASERS

cut thread, and in order to secure such a thread it is necessary to have a good die, consisting of a frame or holder and a set of chasers, made with proper consideration for the following points:

Lip; chip space; clearance; lead; sufficient number of chasers.

Lip is also known as hook or rake, and is the inclination of the cutting edge of the chaser to the surface of the pipe, as shown in Fig. 1.

The lip may be secured by milling the cutting face of the chaser, as shown by the full lines, or by

inclining the chaser, as shown by the dotted lines. The lip angle should be from 15 to 25 deg., depending upon the style and condition of the chasers and chaser holders.

In Fig. 2 is shown a chaser of a properly made die. The chips curl off clean and leave a smooth thread.

Chip space is required in the holder in front of the chaser to allow room for the accumulation of chips, as is shown in Fig. 1, and also provides means for lubricating the chasers. This space should be provided in front of the chaser, with its back well supported. A lack of chip space will cause the chips to clog and tear the threads.

Clearance is the angle between the threads of the chasers and the threads of the pipe. This clearance

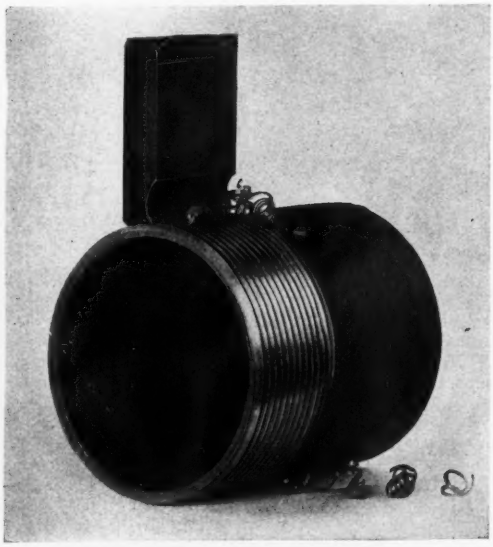


FIG. 2. PROPER FORM OF DIE AND THREAD CUT BY IT

may be secured in various ways, depending upon the position in which the chasers are held in the frame.

Lead is the angle which is machined or ground on the front of each chaser to enable the die to start on the pipe, and also to distribute the work of making the first cut over a number of threads. The lead may be machined on or, as is more frequent, it may be ground on after the chasers are tempered. The proper amount of lead is about 3 threads. As the heaviest cutting is done by the lead, it should have a slightly greater clearance angle than the rest of the threads on the chaser. When regrinding a chaser that has become dull on the lead, care should be taken to give each chaser the same length of lead, as otherwise the work will be unevenly distributed between the chasers in the set.

To get good results in threading at one cut, experience shows that a die should have a suitable numbers of chasers; the approximate number being determined by the size of the die. Experience of the National Tube Co. shows that the dies up to 1¼ in. should have 4 chasers.

1¼	to 4 in.	should have approximately	6 chasers
4	to 7 in.	should have approximately	8 chasers
7	to 10 in.	should have approximately	10 chasers
10	to 12 in.	should have approximately	12 chasers
12	to 14 in.	should have approximately	14 chasers
14	to 18 in.	should have approximately	16 chasers
18	to 20 in.	should have approximately	18 chasers

Good lard or crude cotton seed oil should be used in liberal quantities, as the best die made will not produce good results with poor oil.

A die which is made with regard to these points by an experienced tool maker will thread both wrought iron and steel pipe with equally good results.

Applying these principles to hand dies it is possible for one man to do the work of two. In a paper by T. N. Thomson, read before The American Society of Heating and Ventilating Engineers in 1906, certain tests are described on the power required to thread pipe with hand dies of the common pattern, and with the same type of dies correctly made. The author says:

"It shows that the power required to thread mild steel pipe with the new die is not much more than that required to thread wrought iron with the same die, and much less than the power required to thread wrought iron pipe with the common die."

THE JONES OIL FILTER

ALTHOUGH a recent development, the Jones oil filter, manufactured by the Jones Mfg. Co of Youngstown, Ohio, possesses a number of excellent features which will be recognized and appreciated by men who have to work with oil filters. Being designed by a mechanic who knows the troubles the average engineer has in cleaning filters also troubles with hot bearings caused by oil not being thor-

SECTIONAL VIEW OF THE JONES OIL FILTER

oughly reclaimed, all effort has been made to eliminate the causes of these trouble from the Jones filter.

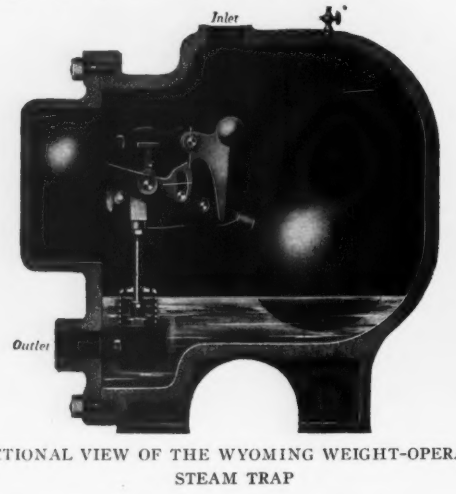
Oil enters the filter through a small cone-shape arrangement attached to lid A6. From there it passes to strainer A8, where all the larger particles of dirt and waste are separated; from this strainer it drops to strainer A10 and is filtered through a fabric, gradually removing the dirt as it passes on its way. From strainer A10 it drops to pan A13, which is set on an incline so that the oil will drain into conductor A14. These strainers and pan are removed by simply dropping the door A12, and sliding them out. To remove the dirt from A8, hit it lightly with the hand a few times, which cleans the wire mesh. The cloth on A10 can be pulled off, and a new one substituted. The pan A13 can be wiped off and this completes the ordinary cleaning process.

The oil having entered conductor A 14, is delivered to the base of tank, and comes up through spreader A15, which breaks it into small globules before it passes up through the water. Entering conductor A17 through a large opening in the partition, it is delivered to the bottom of the heating chamber, which is a separate compartment. By this arrangement no steam coil will come in contact with water which would cause the water to boil and not permit the fine particles of dirt to settle. Another advantage of this arrangement is that the coil is placed where it will thoroughly heat the oil after it has passed through the water washing process, so that the water will separate from it, and in the last stages of the process of filteration the oil being thoroughly hot when it passes through strainers A19 and A20, the smallest particles of dirt and sediment can be removed. These filters are built so that the operator can use his own judgment as to the thickness of fabric to be used.

An excellent system of accessible strainers, consisting of 4, for the oil to pass through, insures thorough filtration; in addition, the method of heating, the gravity and water washing process and simplicity of construction, all combine to make this filter well adapted for continuous oiling systems.

WYOMING WEIGHT-OPERATED STEAM TRAP

ALTHOUGH a float is used in this trap it is only instrumental in releasing the valve weight, which in dropping lifts the discharge valve. The buoyancy or weight of the float is not depended upon to lift the valve from its seat. The weight is a levered cast-iron ball whose weight governs the capacity or size of hole through the discharge valve seat. It is evident that by increasing the valve weight, a discharge valve of almost any size can be operated, thus giving a possibility of any capacity.



SECTIONAL VIEW OF THE WYOMING WEIGHT-OPERATED STEAM TRAP

Construction of the trap is shown by the sectional view herewith. As shown, the trap has discharged, the float is at its lowest position, and the valve weight at its highest position where it has been lifted by the float in its descent. Water enters the trap raising the float to its highest point of travel, when it releases the weight latch, allowing the valve weight to fall, which by the action of a crank instantly lifts the discharge valve wide open. The valve is held in this position by means of the rod latch until the water carries the float to its lowest point of travel, at the same time raising the valve weight. At this point the weight latch again engages and the rod latch disengages, letting the discharge valve close instantly.

Because of the instantaneous action in opening and closing, all chattering of the valve and wire drawing are avoided. Also the instantaneous and full discharge draws the water from the pockets along the line, thus keeping a clear discharge in line. Water level with the float in lowest position is such as to give 1½-in. water seal, which is maintained at all times so that steam cannot escape. The trap is suitable for operation on pressures from 0 to 150 lb., and is made in sizes with inlet connections from ½ in. up to 2 in. by W. H. Nicholson & Co., Wilkes Barre, Pa.

CLOTH PINIONS

CLOTH pinions are highly successful devices for reducing the noise and increasing the life of power transmission gearing. Metallic gearing, especially steel, is always more or less noisy in operation, the noise becoming particularly troublesome in the case of high-speed gear trains. Furthermore,

FIG. 1. 16 TOOTH CLOTH PINION, 2 PITCH, 8¾-IN FACE

iron or brass gearing has not sufficient elasticity to withstand successfully the shocks or backlash caused

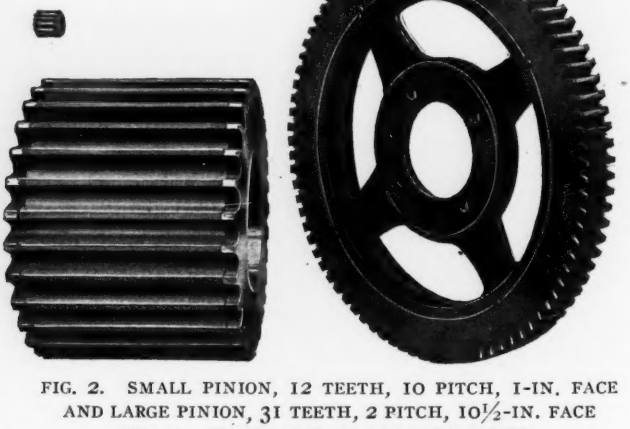


FIG. 2. SMALL PINION, 12 TEETH, 10 PITCH, 1-IN. FACE AND LARGE PINION, 31 TEETH, 2 PITCH, 10½-IN. FACE
FIG. 3. CLOTH GEAR OF LARGE DIAMETER

by the torque variations incident to the operation of machine tools, such as punches, shears, planers, etc.

In the cloth pinions developed by the General Electric Co., the blanks from which the pinions are cut consist of a filler of cotton or similar material confined, at a pressure of several tons to the square inch, between steel "shrouds" or side plates, the whole structure being held together by means of rivets, or, in case

of very small pinions, by threaded sleeves. After the teeth are cut, the cloth filler is impregnated with oil. Cloth pinions are entirely impervious to moisture, unaffected by changes in atmospheric conditions, and absolutely vermin proof.

The teeth are cut to the 14.5 deg. involute system, according to Brown & Sharpe's standard. Diametral pitch is the standard of measurement, and companion gears should be cut to similar form. The teeth are strong and are sufficiently elastic to allow the meshing teeth to bear evenly across the full width of face, thereby enabling the combination to absorb shocks which would fracture cast-iron or brass. The pinions are self-lubricating, operate noiselessly, and have long life. Of several thousands of pinions in operation under severe conditions for periods ranging from a few months to 2 years, none have shown any appreciable signs of wear.

Ordinarily the pinions furnished constitute the smaller members of the gear train, but practically any size and form of gear can be obtained, including a gear of large diameter consisting of a spider with cloth filled rim.

NEW SOLDER IN PASTE FORM

DO you remember, when you were a youngster at home, watching the plumber, tinsmith or electrician heating his soldering iron in a portable furnace and mending the leaks in the pipes, wires or kitchen utensils by melting his solder through contact with the hot iron and soldering stick? And do you recall how he poured on a little acid to form a flux and kept on heating his iron and repeating the process?

Recently a new kind of solder has been placed on the market. It is in the form of a paste in a collapsible tube, put up just like the familiar tube of tooth paste, and all that is necessary for its effective use is to scrape off the surface of the part a little with a knife, squeeze some of the soldering paste on and apply a match, candle or torch. When the paste becomes hot it fuses and solders in the same manner as the old style soldering stick.

The name of this new device is Solderall, and it is being marketed by the H. W. Johns-Manville Co. While this article has been in use only a short time it has met with approval by the trade and the public. Its convenience, cleanliness, economy and many other advantages have naturally made a wide appeal to householders as well as to plumbers, tinsmiths, electricians, hardware and supply stores and others.

CORRECTION

OCCASIONALLY in the preparation of matter for the press room, there comes a rush of work in which errors in text get by the advertising staff. It is seldom that Practical Engineer has to apologize for such mistakes, but in the November issue is an instance which we are glad to correct. On page 125, in the description of the Nelson blowoff valve, the 5th paragraph on the left-hand side, the reference figures should be as follows:

"Lever wrench 12 engages with nut 11. This compresses sleeve 10 on the packing ring, adjusting it to a nicety when the valve is closed." By reading the paragraph with these changed reference numbers the meaning will be entirely clear.

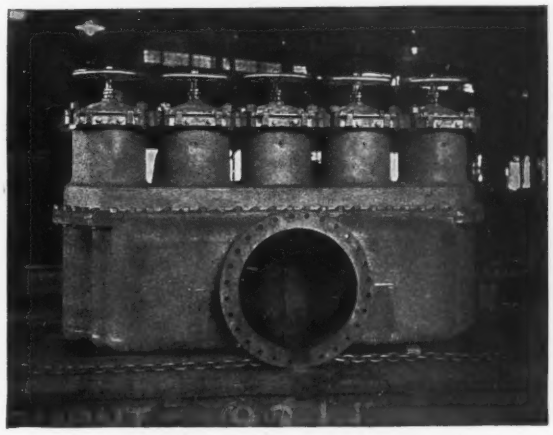
In the 4th paragraph, the right hand column, a "b" got inserted in place of a "p." It should read "no stem packing required."

THE LARGEST WATER STRAINER EVER BUILT

THE accompanying photograph shows one of the 2 strainers recently built by the Lagonda Manufacturing Company, Springfield, Ohio, one furnished to the Toledo Railroad & Light Company and the other to the Metropolitan Street Railway Company, Kansas City, Mo. These strainers are claimed to be the largest ever built for removing foreign matter from water. The total weight of each is 11,000 lb. They measure 10 ft. 1½ in. in width and the height from the bottom flange to the top of the hand wheel is 6 ft. 1 in.

While these figures are impressive, the point which will undoubtedly be most interesting to the operating engineer is the fact that while each of these strainers are built with 5 independent straining baskets, 3 baskets when in operation provide a free area greater than that of the 30-in. pipe in which the strainers are connected, and when all of the baskets are in service the total straining area is several times that of the supply pipe.

While these strainers are of such massive dimensions, very little difficulty is encountered in removing



LARGE LAGONDA WATER STRAINER

the baskets for cleaning purposes. In order to make clear how these baskets are cleaned, it might be stated it is only necessary to turn the hand wheel which raises the baskets entirely out of the strainer, at the same time shuts off the water from the straining compartment. The basket can then be lifted out, all foreign matter removed, and the basket quickly returned.

In service it is recommended that at least one straining basket be kept out of use to act as a reserve. That is, it is raised into the upper half of the strainer body, and when it is desired to clean the strainer, this spare basket can be quickly inserted into the strainer body and the other baskets removed one at a time. It is easily seen that this multiple arrangement of straining baskets provides ample insurance against a total shut-down of the water, and obviates the necessity of having 2 large strainers in duplicate or a duplicate pipe line. In service the mesh of the straining basket is of such a gage that it will suit the requirements of the plant in which it is used.

STICK TO ONE thing is a good maxim, let it become a part of you, however, and not you a part of it.

HUBERT E. COLLINS

THE subject of this sketch was born in Boonesboro, Iowa, March 27, 1872, and spent most of his boyhood in that state. His father being an itinerant minister, he had the advantage of living in several of the towns and cities of his native state before leaving home to take up his life's struggles. Des Moines, Indianola, Council Bluffs, Corning, Chariton and Clarinda, are the places in his native state which contributed to his schooling. This latter was intermittent, as he lived different periods of his teens in the Indian Territory and Colorado, but he managed to get his second year of high school before the exigencies of the family exchequer compelled him to start in earnest to earn his own livelihood.

This same exigency required his breaking into his schooling at times when he worked as farm-hand, surveyor's assistant, ranching and saw-milling in the far west. He always had a liking for any mechanical

work, and when his father moved from Iowa to Beverly, Mass., in the fall of 1890, the younger Collins worked in a novelty wood-working shop, and then a shoe factory, until August, 1891. At this time his uncle, Edwin E. Williams, was chief engineer for the Lake Erie Engineering Works of Buffalo, N. Y., and through him, Hubert started as an apprentice machinist, under Patrick Kane, superintendent, the middle of August, 1891.

He rapidly gained experience in the erecting gangs, and in order that he might acquire diversified knowledge, he corresponded with Frank Rider, superintendent of the Bass Foundry and Machine Works in Fort Wayne, Ind., and arranged to enter its shops on July 1, 1892.

In February, 1893, he left Fort Wayne and worked as a repairing machinist under the master mechanic of the Nonantum Worsted Mills, Newton, Mass., until August 1, when he came to New York to join his parents, who were going to Africa as missionaries. This trip did not materialize, and he found employment with C. W. Hunt on Staten Island, as a machinist. The hard times of 1893 practically shut down these shops soon after his employment there, and in October, 1893, he went to Colorado again, and not finding employment as machinist, he worked on his brother's ranch until May, 1894, when he was employed by William Tod & Co., Youngstown, O., under Supt. Douglas, as an erecting engineer.

He was sent with the erecting gang to Brooklyn and assisted in the erecting of the 2, 3-cylinder compound, vertical 1200-hp. William's engines at 360 Pearl Street, Edison Station. At this time these were the largest engines in lighting service in that city. After this he worked for a time as repairing machinist for Berrang and Zacharias in Asbury Park, and then entered the Ames Iron Works, Oswego, N. Y., under Supt. William J. Armstrong. He worked on the erecting floor and on the testing block and outside erecting from May, 1895, to April, 1896. He was again sent out on the road by Wm. Tod & Co. in the spring of 1896, and worked setting up the 2 William's engines in the Mill Street Plant of the Long Island City Electric Light and Power Company.

After setting up these engines he took out his first engineer's license and was engaged under D. W. Murphy in this plant as operating engineer, from October, 1896, to September, 1898. From September, 1898, to January, 1900, he was first assistant engineer under Chas. Carroll in the Gwinnett Street, Brooklyn, Edison Station. For a few months in 1900 he again filled his old position in Long Island City, under A. T. Witherill.

In the fall of 1900 he left the engine-room and became the secretary of the Ambrose Machinery Company of Brooklyn, N. Y., and had charge as superintendent of outside repairs until the fall of 1902. During this time he had full charge of overhauling and repairing in many of the power houses in Greater New York. In the fall of 1902 he opened his own office as consulting and contracting engineer. The first 4 yr. he followed engineering contracting chiefly, but of late years has followed consulting exclusively. For 20 months of this time he acted as general manager and vice-president of the Engineering Supervision Company of New York.

In 1908 he devoted much of his time to writing for technical papers and produced the "Power Hand Books," Erecting Work, Knocks and Kinks, Shaft Governors, Pipes and Piping, Shafting Pulleys and Belting, Pumps, Boilers and Steam Turbines. He is also the author of "Valve Setting" (which is from his own personal experiences), and some 38 separate articles.

He has also served as instructor in plant management, Class 86-11, Teachers' College, Columbia University, 1910-11, and is engaged for 1911-12. In 1900 he joined Jas. Watt Association No. 7, N. Y. N. A. S. E., where he still retains his membership. He served as chairman of the educational committee for 3 seasons, one year as vice-president and 2 terms as president. Was elected delegate to national conventions at Richmond and Philadelphia; elected delegate to New York state conventions at Utica, Syracuse, Niagara Falls, Newark, Geneva and Albany; served as state secretary of New York State Association 3 terms and as state president 1 term. During his incumbency as secretary the New York State Association was built up from a membership of 17 subordinate associations to 46. He is an honorary member of Phoenix Association No. 24, N. A. S. E., N. Y. He is affiliated with Metropolitan Lodge No. 273, F. and A. M., and is also a member of the Iowa Society of New York. He has been a member of the Modern Science Club of Brooklyn 9 years.

At the inception of the Institute of Operating Engineers, he associated himself with the work, and for the past year has acted as its secretary, being re-elected to the position for 1 year at the annual meeting, September 1st to 3rd, 1911.

NEWS NOTES

BEST MANUFACTURING CO., of Pittsburgh, Pa., has appointed Charles E. Hague as Philadelphia representative with headquarters at 1510 Land Title Building. He is to have charge of Eastern Pennsylvania, Baltimore and Washington territory. Also the Company has appointed C. L. Stickney & Co., as its representative in the states of Washington and Oregon, with headquarters at 108 White Building, Seattle, Washington.

ENGINEERS' ASSOCIATION No. 1 of Louisville, Ky., has arranged an interesting series of meetings for the winter which includes papers and addresses as folows: Boiler Fitting, by Frederick L. Ray; Boiler Cleaning by J. E. Thierman; Boiler Contruction by James Veatch; Boiler Efficiency and Horsepower by E. F. Gross; Boiler Inspection by W. A. Druck; Steam Piping by Henry Childers; Pumps and Their Troubles by C. E. Kaufman; Central Station vs. Isolated Plants by A. M. Cowherd; Cost of Generating One Kilowatt Hour in a 100 Kilowatt Plant, by A. McKinley; Operation of Compression Refrigeration Machine, by Geo. Romple; Analysis of Flue Gases, by Prof. W. E. Janes; Gas Producer, by Thomas Hopkins; Gas Engine Operation, by Ed. Kochenrath; Electric Motors, by J. D. Gregory; Regulating Valves, by C. L. Frank; Water Softening Plant, by Ed. Meyer; Alternating Current, by B. N. Grosvenor; Direct Current, by C. E. Fertig.

MAIN OFFICES of A. Eugene Michel, advertising engineers, have been moved into the Park Row Building, 21 Park Row, New York, where larger space has been secured, as necessitated by constantly increasing business.

C. D. CHASTENEY has resigned his position as sales manager of De Laval Steam Turbine Co., of Trenton, N. J., having acquired an interest in the Turbine Equipment Co., of 30 Church St., New York, which company represents the De Laval Steam Turbine Co., in New York State, parts of New Jersey and Connecticut. Mr. Chasteney was graduated from Stevens Institute of Technology in 1901 and has been with the De Laval Steam Turbine Co. since the organization of the American company over 10 yr. ago.

COL. GOETHALS BRANCH (Yazoo City, Miss.) of the Institute of Operating Engineers, started its regular semi-monthly meetings the last part of September. The following papers were read at the meeting Oct. 14: Safety Valve Calculations by J. Chisholm (Junior Apprentice I. O. E.); Safe Working Pressure of Boilers, by F. C. Holly (Master Operating Engineer, I. O. E.); Boiler Horse power, by W. G. Richardson (Master Operating Engineer, I. O. E.). In this branch it has been decided to conduct a full course in which papers will be presented covering the subject, "The Boiler Room and its Special Attachments," and all the problems connected therewith that an operating engineer should know. At each meeting the members are given a subject for discussion at the next meeting.

The New York Branch held a meeting on Oct. 20 and voted to name the branch after J. C. Jurgensen, the founder of the Institute. In this branch it has been decided to give a course of lectures during the winter on Power Plant Accounting.

The new educational bulletin is ready for distribution, and gives the announcement of special rates secured from the correspondence schools for students who wish to take up the I. O. E. work by the correspondence method.

T. J. Waters Branch of Chicago held its monthly meeting Nov. 7, and was addressed by J. P. Fleming (Master Operating Engineer), on Steam Boilers, giving the requirements for good efficiency and illustrating how they are met in the design of commercial apparatus. This branch meets on the first Tuesday of each month in Room 1735 Monadnock Block.

THE ANNUAL MEETING of the American Society of Mechanical Engineers will be held in the Engineering Building, New York City, Dec. 5-8. The afternoon of Dec. 5 will be devoted to registration and renewing acquaintances, the evening to the president's address, and to a reception in the Society's rooms.

December 6 a business session will be held at 10 o'clock, luncheon will be served at 1, and the afternoon from 2 to 4 will be devoted to a professional session. From 4 to 6 a ladies' reception will be held in the society's rooms, and at 8 o'clock a lecture will be delivered. December 7, will have a professional session at 10 o'clock, luncheon at 1, inspection and excursions at 2, and a reunion at the Hotel Astor at 9 o'clock in the evening. December 8, will have a professional session at 10 o'clock in the morning and, at 2 in the afternoon, an excursion to the Brooklyn Navy Yard to inspect the shops, ships, and arrangements at the yard.

WE ARE ADVISED by the International Acheson Graphite Co., of Niagara Falls, N. Y., that a grand prize has been awarded to it by the Jury of Awards, of the Turin, Italy, Exposition. The news comes to them through the United States Government representative at the exposition, who sends the information through the Department of the Interior, Bureau of Mines.

The International Acheson Graphite Co. has exhibited in all the world's great expositions, and has been given the highest award. The present grand prize continues the recognition that is given to the advancement of science as represented by the processes operated in the wonderful plant of the company at Niagara Falls. The furnaces which are heated by electric current produce a pure, unctuous graphite, which is entering more and more largely into the meeting of our every-day needs, and this last award is additional testimony to the creative genius of Doctor Edward G. Acheson, the inventor of the process for manufacturing graphite. Doctor Acheson has been on a delightful European tour, from which he will shortly return.

THE JEFFREY MANUFACTURING CO., of Columbus, Ohio, which manufactures mining, elevating, conveying and power transmission machinery and coal mine equipment, has recently opened another branch office at 1201 American Bank Building, Seattle, Wash., from which will be handled its business in the Northwest.

Percy E. Wright, the Seattle manager, is a sales engineer who has been connected with the home office for the past 10 years, and is thoroughly conversant with the conditions in the Northwest territory, as he has been traveling in that part of the country for a number of years.

The Jeffrey Manufacturing Co. is maintaining 13 branch offices in the United States, as well as nearly 100 agencies in the leading commercial centers all over the world.

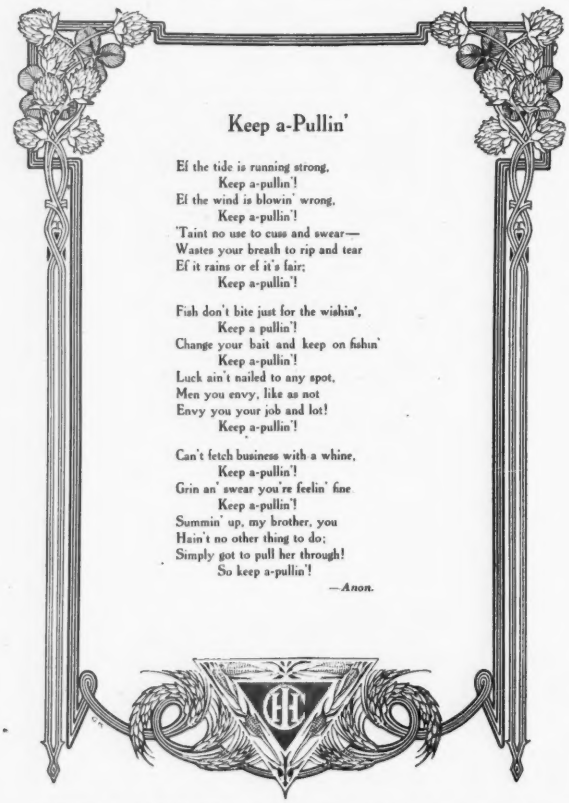
CATALOG NOTES

BULLETIN NO. 36 of the Bates Machine Co., Joliet, Ill., describes and illustrates the new Bates Inertia Valve Gear, which is now regularly applied to all Bates Corliss Engines. This new gear has attracted much attention because of its positiveness and quiet operation, and the absence of hooks, springs and rollers.

SCIENTIFIC LUBRICATION OF MACHINERY is the title of an attractive 48-page publication issued by The Richardson-Phenix Co. This book gives

a detailed description of Richardson-Phenix Individual Oiling and Filtering Systems and their many types of oil filters, mechanical lubricators, oil and water separators, sight feed and gang oilers, union-cinch pipe fittings and sight flow indicators, etc. It has a fund of information on power plant lubrication and is well worth reading, as it shows how highly this branch of engineering has been perfected for modern power plants.

THE OCTOBER ISSUE of Harvester World has many good things of especial interest to those engaged in manufacturing and selling I. H. C. products. But perhaps the best of all is the last of all, which applies to us all, and is reproduced herewith:



Keep a-Pullin'

Ef the tide is running strong,
Keep a-pullin'!
Ef the wind is blowin' wrong,
Keep a-pullin'!
'Taint no use to cuss and swear—
Wastes your breath to rip and tear
Ef it rains or ef it's fair;
Keep a-pullin'!

Fish don't bite just for the wishin',
Keep a pullin'!
Change your bait and keep on fishin'
Keep a-pullin'!
Luck ain't nailed to any spot,
Men you envy, like as not
Envy you your job and lot!
Keep a-pullin'!

Can't fetch business with a whine,
Keep a-pullin'!
Grin an' swear you're feelin' fine
Keep a-pullin'!
Summin' up, my brother, you
Hain't no other thing to do;
Simply got to pull her through!
So keep a-pullin'!

—*Anon.*

THE INGERSOLL-RAND CO., 11 Broadway, New York City, has issued a new catalog, Form 3211, bulletin of 20 pages, descriptive of Imperial Type X duplex steam driven compressors. Catalog shows several views of the machine in section and gives tables of standard sizes and capacities. These machines have massive, well-braced structure, unusually generous bearing surfaces, mechanically actuated air intake valves with large, direct passages, and cushioned discharge valves. The air cylinders of all Imperial Compressors have water-jacketed barrels and heads, the latter being hooded for the admission of cool, clean air. The smaller compressors, up to 16 in. stroke, have overhung cylinders. On larger sizes the air cylinders are supported on a strong foot piece resting upon a sole plate on the foundation, and may be slid away on this sole plate when it is necessary to detach the cylinder from the frame.

COMPARATIVE TESTS OF Large Engine and Turbine Driven Centrifugal Pumps is the title of an article by Francis Head, which recently appeared in one of the technical journals and has been reprinted by the DeLaval Steam Turbine Co., of Trenton, N. J. The tests were made at the Torresdale Filter Plant of Philadelphia, where there are installed 7 compound-engine-driven centrifugal pumps, each having a capacity of 45 million gallons a day against a head of about 45 ft. and one steam-turbine-driven centrifugal pump of a capacity of 50 million gallons per day against the same head. During the past year 6 of the engine-driven pumps and the turbine-driven pump have been carefully tested for economy, according to the specifications, by representatives of the contractors and of the city. The pamphlet before us gives the detailed results of the test, which show favorably for the turbine-driven pump.

THOMPSON HORIZONTAL EDGEWISE Instruments for switchboard service are described in Bulletin No. 4866. This bulletin supersedes all previous bulletins issued by the General Electric Company devoted to this type of instrument.

The General Electric Company has just revised its bulletin devoted to Single-Phase Repulsion Motors. The new bulletin is numbered 4858.

Bulletin No. 4849 on the subject of Motor-Generator Sets contains brief descriptions of generator sets of different styles and sizes. These sets are made up of various combinations of alternating and direct current generators and motors, and range in capacity from 95 to over 7000 kw.

In Bulletin 4868 are illustrated and described rotary converters for railway and lighting, in capacities ranging from 25 to 2500 kw.

Bulletin 4878 is devoted to Cloth Pinions. This remarkable and somewhat radical form of machine element is offered for a wide variety of application in mechanical transmission of power where, because of noise or for other reasons, the meshing of metallic pinions with metallic gears is impracticable or undesirable.

BULLETIN 1512, from the Allis Chalmers Co., describes its Compound Corliss Engine, including the heavy duty type for belting, the heavy duty compound for direct connection to dynamos or machinery, the tandem compound direct connected, the reliance belted and direct connected, and other types including the vertical compound, direct connected. Bulletin 108, issued by the same company, is devoted to Allis-Chalmers alternating current generators, of engine and flywheel types, and shows the details of the windings and parts as well as the general appearance of the machine.

BULLETIN 106 from the Wheeler Condenser & Engineering Co., describes in detail that make of high vacuum surface condensers for steam turbines, and the apparatus such as dry vacuum pumps and circulating pumps that go with it. Bulletin 107, by the same company, describes high vacuum jet condensers, showing in detail the rectangular form of Wheeler jet condensers and giving results with this type.

AN UNIQUE CATALOG of flumes, gotten out by the Hess Flume Co., 635-636 First National Bank Bldg., Denver, Colo., shows the shape of the flumes, gives tables of the carrying capacity of different sizes, and explains the advantages of the flumes, which are made of galvanized Toncan metal. The sections are joined by interlocking joints, which are watertight and give a perfectly smooth interior. Details of construction as well as dimensions are shown in the catalog which is printed in imitation of blue print work.

THE INTERNAL MANIFOLD Water Heater, made by David C. Seymour, of Newark, N. J., has a

cast head and pipe for carrying the steam through the heater instead of the usual pipe coil. The advantages are fully explained in a booklet issued by the company.

FROM WENTWORTH INSTITUTE, Boston, Mass., comes an interesting catalog showing its courses and giving illustrations of the kind of work done. The courses will be of 3 kinds, one-year day courses, 2-year day courses, and evening courses. The function of the Institute is to furnish education in the mechanical arts. The ground covered will be iron and wood working, electric wiring, mechanical drawing, plumbing, practical mathematics, applied electricity, and the steam engine and operation of power plants. Full information can be had by applying to Arthur I. Williston, Principal, Wentworth Institute, Boston, Mass.

FIRE BRICK FOR BOILER SETTINGS, is certainly an important part of power plant equipment. A full discussion of this material in the new book of the Harbison-Walker Refractories Co., of Pittsburgh, Pa., is an important contribution to power plant information. This book is one worthy of the company which publishes it, both as to appearance and value of the information contained. It is a substantially bound booklet dealing first with typical special shapes of fire brick which have been required for boiler settings, and made by the Harbison-Walker Refractories Co.; then showing the facilities of the company for turning out work in a hurry for a quick repair; then going on to the standard shapes which are always kept in stock and which are sufficient for practically all ordinary boiler settings; then describing the special tongue and groove fire box blocks and how to measure up for door, arch and jamb brick; then illustrating and describing typical baffle and back combustion arch tile; and finally telling briefly and in an interesting way the story of how fire brick for boiler settings is made, giving illustrations of the work in process at the plant of the company. Not the least valuable feature of the book is a series of sections of different boilers showing the method of installing a proper and efficient setting. This includes the tubular boiler and all the prominent makes of water tubes, both horizontal and vertical. General information about fire brick and how to choose different shapes to give a circle or arch of any diameter; mathematical tables as well as tables of temperatures and properties of various material are included in the latter part of the book. Altogether there are 76 useful pages, and the information can be had without cost by writing to the above company at its Pittsburgh office.

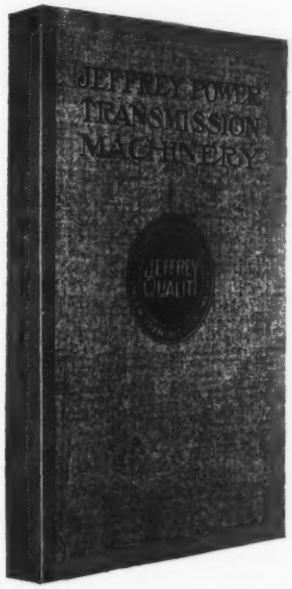
THE THERMOMETER BOOK is a discussion of the Tycos thermometers and their use in daily life, and illustrates the different forms manufactured. The types illustrated form an attractive line, and can be had from the Taylor Instrument Co., of Rochester, N. Y., "where the thermometers come from."

KERR TURBINE CATALOG No. 19, superseding Bulletin No. 18, has just been issued by the Kerr Turbine Co., Wellsville, N. Y. This catalog is a thorough treatise on the theory, construction, uses and advantages of small steam turbines for driving generators, pumps, blowers, and other small high-speed machines.

THE BLACKBURN-SMITH Pressure Filter is described in a new catalog just issued by James Beggs & Co. This filter is based upon small easily removable and renewable cloth-covered cartridges for removing suspended matter from hot or cold water.

FROM THE Sterling Machine Co., of Norwich, Conn., comes bulletin No. 103, describing the Acme Automatic Steam Engine for driving blowers, pumps, generators, stokers, rock drills, and so forth. It is of the single acting, 2-cylinder type, with a pair of vertical cylinders above an enclosed crank case and an oscillating valve. The bulletin gives interesting details of construction, and shows many convenient applications for permanent and temporary use.

AMONG THE NEW PRODUCTS of the Jeffrey Mfg. Co., of Columbus, Ohio, a special feature described is the Jeffrey Improved Split Iron Pulley,



which can be readily clamped on the shaft without disturbing any other equipment, or may as easily be removed from the shaft when necessary. Also a complete line of wood split pulleys is shown and a list of spur, bevel, mitered, angle reduction and angle miter gears.

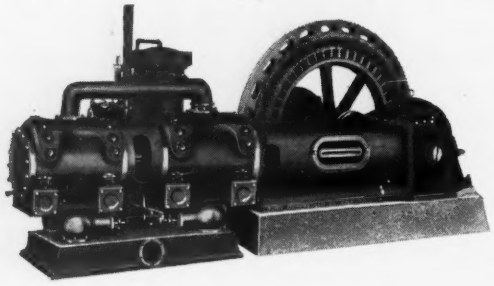
CATALOG D, on speed reducing transmission gears, issued by the D. O. James Mfg. Co., of Chicago, Ill., shows the construction of these gears, for application to various forms of machinery, methods of tests which show an efficiency of from 80 to 93 per cent in the transmission, and at the end of the catalog are given many tables on transmission of power by gearing, by sprocket wheels, by pulleys, and mathematical tables. The catalog is a cloth bound book of 112 pages, filled with interesting data on power transmission.

FROM THE DIAMOND POWER SPECIALTY CO., of Detroit, has been received an interesting series of bulletins, describing the different types of Diamond soot blowers. The first of these gives description of the blower especially adapted for Stirling boilers, the second for blowers arranged for the Heine boiler, the third as arranged for Wickes vertical type water-tube, the fourth for fire-tube boiler, the fifth for Manning upright boilers, and the sixth for Babcock & Wilcox and similar horizontal water-tube. All these are fully illustrated and give complete detailed description of construction and operation of the different types.

NEW AND VALUABLE Publications of the Bureau of Mines, Department of the Interior, are announced as follows: Bulletin 13. Resume of producer-gas investigations, by R. H. Fernald and C. D. Smith. 1911. 378 pp., 12 pls. Miners' Circulars 5. Electrical accidents in mines; their prevention and treatment, by H. H. Clark. 1911. Bulletin 24. Binders for coal

briquets, by J. E. Mills. 56 pp. Reprint of United States Geological Survey Bulletin 343. Copies will not be sent to persons who received Bulletin 343. Bulletin 28. Experimental work conducted in the chemical laboratory of the United States fuel-testing plant, St. Louis, Mo., January 1, 1905, to July 31, 1906. Reprint of United States Geological Survey Bulletin 323. Copies will not be sent to persons who received Bulletin 323. Bulletin 27. Tests of coal and briquets as fuel for house-heating boilers, by D. T. Randall. 45 pp., 3 pls. Reprint of United States Geological Survey Bulletin 366. Copies will not be sent to persons who received Bulletin 366. Bulletin 35. The utilization of fuel in locomotive practice, by W. F. M. Goss. 28 pp. Reprint of United States Geological Survey Bulletin 402. Copies will not be sent to persons who received Bulletin 402. The Bureau of Mines has copies of these publications for free distribution, but can not give more than one copy of the same bulletin to one person. Requests for all papers can not be granted without satisfactory reason. In asking for publications, please order them by number and title. Applications should be addressed to the Director of the Bureau of Mines, Washington, D. C.

THE BURY COMPRESSOR CO., Erie, Pa., has recently developed and brought out its new Patented Variable Volume Air Compressor, especially designed for economy and efficiency and to reduce the cost of



operation in the mining districts and other places where current is purchased based on daily peak load of compressor. This new variable volume machine is so designed, that, besides being entirely automatic, it provides for reducing the peak load in accordance with the requirements for any length of time automatically.

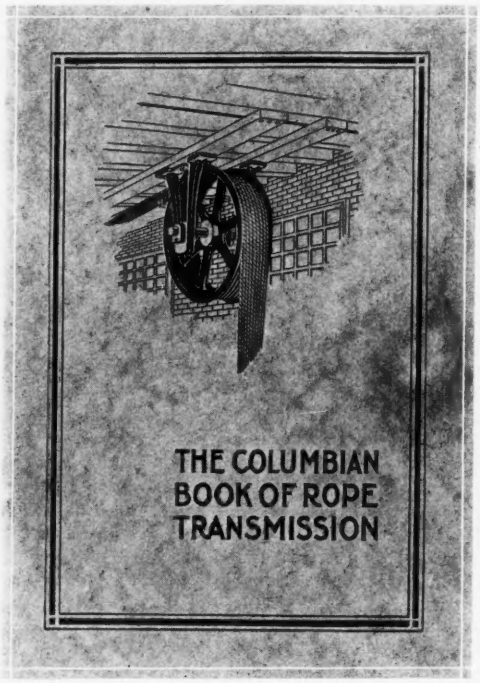
The company is building several of these compressors at present, and cut of one of these compressors with synchronous motor mounted directly on shaft is shown herewith.

There are building at the present time 2 large units of the belt-driven type corresponding to those with synchronous motor mounted on the shaft.

The great difficulty which has so long confronted operators and users and purchasers of equipment in territory where current is purchased based on peak load, has in this equipment been entirely overcome, eliminating thereby a large and unnecessary item of expense. The Bury Compressor Co. will be pleased to send to any prospective customer who is interested in this equipment, full details with new bulletin recently issued, upon request.

"BE READY FOR the long dark nights" is the title of Bulletin No. 22 just issued by Kerr Turbine Co., Wellsville, N. Y., describing and illustrating installations of their Turbo-Generator sets for lighting. This folder is well worth reading by any one who is figuring on an independent lighting plant. A copy will be sent upon request.

WHOEVER IS INTERESTED in Rope Transmission will find the Columbian Book of Rope worth while. The book, in the first place, is handsome and attractive as a piece of typographical work. The type is large and clear, soft brown on a handsome paper and with attractive display headings in black. Illustrations are carefully chosen and give a clear idea of the subject under discussion, which is the transmission of power by means of manila rope. The subjects discussed are rope drives in general, the multiple versus the continuous system, and the combination of the 2 in the same mill; the advantages of rope drives in the transmitting of power from large units, safety against accidents, transmitting over long distances, economy of drive, steadiness, freedom from noise, ability to go around corners, and freedom from slip. Details of a rope transmission such as the proper grooves and sheaves, necessary qualities of the rope, the proper



breaking strength, and the horsepower transmitted at different speeds are all given. There are also practical points for the man in charge of a rope transmission, with instructions how to handle and order transmission rope. This valuable book can be had by writing to the Columbian Rope Co., at Auburn, N. Y., and mentioning Practical Engineer.

FROM THE BROWNELL CO., of Dayton, Ohio, has been received an interesting and novel catalog on variable speed engines especially built for paper machines. Two styles are shown, one for a range of speed from 6 to 1, accomplished by means of a speed changing device, and the other for a speed of 3 to 1, accomplished by regulation of the governor. The engine itself is the regular Brownell Twin Engine, with throttling governor, built extra heavy in all parts to stand any unusual strain. The catalog gives full information and can be had by writing the Brownell Co., at Dayton, O.

TRADE NOTES

THE ATLANTIC CREOSOTING AND WOOD PRESERVING WORKS of Norfolk, Va., recently had a fire in its plant, which destroyed the pump-house with all its contents, thus putting the entire plant out of commission and subjecting the company to an enormous daily loss, owing to unfilled contracts. It may be of interest to note that the Blake & Knowles Steam Pump Works, 115 Broadway, New York City, supplied them with an entire new equipment of pumps, consisting of one carload, which was shipped in 3 days after the order was placed. These pumps consisted of vacuum pumps, pressure pumps and tank pumps for handling creosote oil and also a large air compressor.

DUE TO THE FAST INCREASING business in Birmingham, Ala., the H. W. Johns-Manville Co., has found it necessary to change the location of its office from 1220 Empire Building to 606 Chamber of Commerce Building, this address being better adapted for its requirements. Its office will continue under the management of W. H. Fleming, who is well and favorably known throughout this section of the country, having been connected with the New Orleans branch of this company for a considerable time. A complete line of well-known J-M Asbestos and Magnesia products, electrical supplies, packings, etc., will be handled from this office.

THE WESTINGHOUSE ELECTRIC AND MANUFACTURING CO. has recently received as subcontractors through the John W. Danforth Co., Buffalo, New York, a contract from the United States Navy Department for an additional electrical equipment for the central power plant at the Mare Island Navy Yard in California. This equipment includes 6 induction motors with a double equipment of 142.5 hp., both single and double speed motors for driving the circulating and condensing pumps in the power house. The contract also includes 3 50-kv.a. transformers for reducing the voltage of the generators for the motors; one 20-kw. motor-driven exciter set, 2 25-kw. turbo-generator exciter sets, one 19-panel station switchboard, and one distributing panel. The generating equipment for this station was purchased some time ago and includes one Westinghouse-Parsons 1000-kw. 2200-volt turbo-generator. The equipment is to comply with the specifications of the Bureau of Yards and Docks of the Navy Department.

MANUFACTURERS OF THE Taylor Stoker report recent orders as follows: Hartford Electric Light Co., 2 stokers; New York, New Haven and Hartford Railroad (Bridgeport plant), 2 stokers; The Solvay Process Co., 1 stoker; Columbia Shade Cloth Co., 3 stokers, for their plants at Chicago and Minetto, N. Y., and the Fisk Rubber Co., 1 stoker. The first 3 of these are repeat orders.

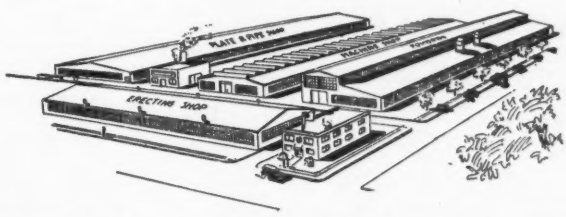
THE AMERICAN BLOWER CO. of Detroit, with a factory also at Troy, New York, and branch offices throughout the world, has realized the importance of the Dominion of Canada, and has just filed application for a charter for a company to be known as the Canadian Sirocco Co., Ltd., of Windsor, Ontario.

This company has acquired from the City of Windsor a tract of land, centrally located, comprising about 4.5 acres, situated on the Essex Terminal Railway, and will proceed at once with the erection of a plant which, when completed, will doubtless be one of the most complete of its kind on this continent.

A perspective of the proposed buildings is herewith reproduced. The company is proceeding at once with the construction of the Erecting Shop, 50 by 200 ft., to be of steel and concrete construction, also the office building. This is about all that it seems possible to complete for occupancy this winter. In all probability the foundry building will come next and will be started in the spring. The company will hold the exclusive patent rights for the manufacture in Canada of the Sirocco fans and blowers which have especial space and power saving features.

The Canadian Sirocco Co. will also manufacture the full line of the American Blower Co. products, consisting of fans, blowers, heating, ventilating, drying apparatus, steam engines, steam traps, etc.

The blower business depends upon the sciences of pneumatics, thermodynamics and electricity, hence is



essentially an engineering industry, and the expert knowledge of how to apply such special apparatus for producing efficient results as possessed by the engineering staff of the American Blower Co. will be at the disposal of the Canadian Sirocco Co., establishing it at the outset in a unique position.

THE VILTER MFG. CO., with offices at 972 Clinton St., Milwaukee, Wis., report the following list of recent sales: J. L. Krez Mfg. Co., St. Louis, Mo., 12½-ton refrigerating plant; Yakima City Creamery, North Yakima, Wash., combined 20-ton refrigerating and 6½-ton ice-making plant; Beatrice Creamery Co., Lincoln, Neb., 230-ton refrigerating machine and 26 by 48-in Corliss engine; Atlantic Ice & Coal Corporation, Atlanta, Ga., 375-ton refrigerating machine and 30 and 54 by 38-in. cross compound Corliss engine; Booth Fisheries Co., Chicago, for Winnipeg, Man., 25-ton belt driven high-pressure side and direct expansion piping; Hotel Raymond, Raymond, Wash., brine refrigerating and 500-lb. can ice plant; Walter Steers, packer, Markesan, Wis., 2-ton refrigerating plant; Geo. G. Harlan, Packer, Mauch Chunk, Pa., 25-ton can ice plant and 16 by 36-in. Corliss engine.

THE OHIO BLOWER CO of Cleveland, Ohio, reports recent sales of Swartwout ventilators to the following concerts: 1 30-in. to the Southern Heating & Metal Co., Atlanta, Ga.; 1 30-in. to the First National Bank, Havre De Grace, Md.; 3 48-in. to W. H. Brussor, Vicksburg, Miss.; third order of 4 36-in. for the International Heater Co., Utica, N. Y.; 3 36-in. to the Conser Laundry Co., St. Joe, Mo.; 1 24-in. to the Co-operative Foundry Co., Rochester, N. Y.; 3 24-in. to Willow Springs Brewing Co., Omaha, Neb.; 2 36-in. to The Jacob Jacckle Furniture Co., Buffalo, N. Y.; 6 24-in. to The Crystal Paper Co., Middletown, Ohio; second order of 1 36-in. to W. H. Haskell Co., Toledo, Ohio.; 19 18-in. and 1 45-in. to Bollinger Bros., Pittsburgh, Pa.; second order of 30 36-in. to the Champion Coated Paper Co., Hamilton, Ohio; 5 24-in. to The Ohio Valley Clay Co., Steubenville, Ohio; second order of 2 24-in. to the Ohio Paper Co., Miamisburg, Ohio; 4 18-in. to the Progressive Pulp & Paper Co., Plattsburg, N. Y.

PRACTICAL ENGINEER CLASSIFIED ADVERTISEMENTS

Advertisements in this section are inserted under regular headings at the rates of 40 cents per line. About nine words make a line. No display type allowed, but the first three words may be set in capital letters. Minimum space sold, two lines.

Under classification, "Positions Wanted," advertisements not exceeding four lines will be inserted for subscribers once free of charge.

To insure proper classification, copy must reach this office on or before the 20th of month preceding publication.

Positions Wanted

POSITION WANTED—As assistant engineer. Ten years' experience with engines and boilers, also some experience with D. C. generators. Steady, sober and industrious. References. F. F. Ninman, Shawano, Wis. 12-2

POSITION WANTED—In a small light or power plant or act as assistant in large one. Have had 6 years' experience in handling steam. Can furnish the best of references. Address Ray Cole, Mankato, Kansas. 12-1

POSITION WANTED—By experienced steam, hydraulic and electrical engineer, competent to manage small A. or D. C. plant, position of engineer, electrician or assistant. References. W. Steele Evans, Falls City, Oregon. 12-1

POSITION WANTED—By thoroughly capable man with 17 years' experience in steam and electrical work. Have good reputation, and will consider any reasonable offer. Address Box 195, Practical Engineer, Chicago, Ill. 12-1

POSITION WANTED—Young man with fair technical training in theory of steam and electrical machinery wants opportunity to get experience. References. Any reasonable offer accepted. Give particulars. Address Box 360, East Jordan, Mich. 12-1

POSITION WANTED—By chief engineer. Licensed and experienced in electric light and power plants. Simple and cross-compound Corliss and high speed engines, water-tube and return tubular boilers. Age 31. West preferred. Addrss Box 193, Practical Engineer, Chicago, Ill. 12-1

POSITION WANTED—By married man, 33 years of age. Strictly temperate, good education. Have had 10 years' experience on road as steamfitter foreman, in steam, hot water, hydraulic and vacuum system. Desire permanent position in one city. Best references. Address Box 194, Practical Engineer, Chicago, Ill. 12-1

Help Wanted

SELLING AGENTS WANTED in important centers for Betson Plastic Fire Brick. See page 150 in this issue. Betson Plastic Fire Brick Company, Rome, New York. 12-tf

COMPETENT AND EXPERIENCED stoker erectors at once. State age, experience, reference and salary expected. Give full details. Address Box 168, Practical Engineer, Chicago, Ill. tf.

BE AN AGENT FOR Practical Engineer in your city. Pleasant part or whole time work calling on your engineer friends. Liberal cash commission on every subscription taken. Write to Subscription Dept. for information. 11-2

THE VULCAN SOOT CLEANER offers an exceptional opportunity for power specialty salesmen. The Vulcan Soot Cleaner is adapted to all types of boilers. For particulars address G. L. Simonds & Co., No. 803 Steinway Building, Chicago. 7-6

HELP WANTED—ENGINEER WANTED in every city and town to instruct our customers in indicator practice. If you have a fair working knowledge, we will "do the rest." Good pay to reliable, intelligent men. See our adv. on page 17. Write for particulars. Lippincott Co., Newark, N. J.

ENGINEERS AND MECHANICS—To make big money selling Incomparable "ZIZ" Hand Soap. A 10-cent can will instantly remove more dirt and stains from the hands than four cakes of any soap made, and will not injure the most delicate skin. Small sample free. Byram Mfg. Co., Box 3133, Boston, Mass. 4-tf

AGENTS WANTED TO HANDLE ESTABLISHED steam specialty which is known all over the country. Can be handled with non-conflicting specialties. Will give exclusive agency only for amount of territory actually covered by agent or his salesmen in the following states: Virginia, North Carolina, South Carolina, Oklahoma, Wyoming, Georgia, Arizona, New Mexico, Montana, Idaho, Florida, Arkansas, North Dakota, South Dakota. Address Post Office Box 1754, Pittsburgh, Pa. 9-tf

BOILER MEN—Several energetic men who are familiar with the operation of steam boilers can secure good positions as salesmen on straight salary and in good territory. In making application, state age and experience. Address Box 197, care Practical Engineer. 12-2

Wanted

WANTED—A THOROUGHLY UP-TO-DATE engineer in a thriving western city is opening an information bureau for the purpose of furnishing reliable and authentic advance information to manufacturers of power machinery and specialties where enlargements, replacements or new plants are contemplated. Full particulars with enrollment rates will be furnished on application. Address Information, Practical Engineer, Chicago, Ill. 12-3

IF YOU ARE a night engineer, spend a few hours each day taking subscriptions for Practical Engineer. You will be paid well. Write the Subscription Dept. They will start you in at once. 11-2

WANTED—5,000 STATIONARY ENGINEERS to send us their name and address. A good proposition open to each one. For full particulars, write Henry W. Lord, 7 S. Greene St., Baltimore, Md. tf

For Sale

FOR SALE—INDICATOR, REDUCING WHEEL, planimeter best make in fine order. Examination allowed before payment. Price low, in fact a sacrifice. Address Mrs. N. L. Browning, East Orange, N. J.

Patents and Patent Attorneys

PATENTABLE IDEAS WANTED—Send for 3 free books. R. B. Owen, 28 Owen Bldg., Washington, D. C. 7-tf

PATENTS FOR SALE on three different types of steam traps, including the patterns and drawings for same. Address Box 186, Practical Engineer, Chicago, Ill. 9-tf

PATENTS—H. W. T. Jenner, Patent Attorney and Mechanical Expert, 608 F St., Washington, D. C. Established 1883. I make a free examination and report if a patent can be had and the exact cost. Send for full information. 10-tf

PATENTS—C. L. Parker, late Examiner U. S. Patent Office, Attorney-at-Law and Solicitor of Patents. Patents secured promptly and with special regard to the legal protection of the inventors. Handbook for investors sent upon request. 186 McGill building, Washington, D. C. 4-tf

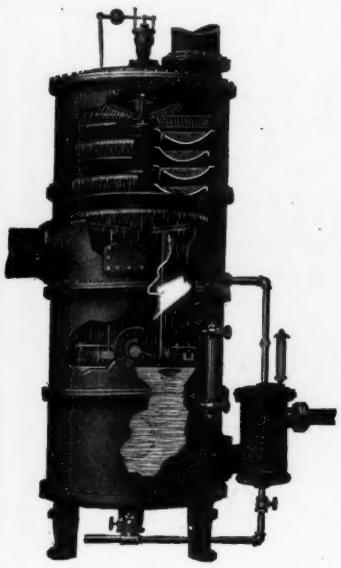
Educational and Instruction

DYKE'S AUTO INSTRUCTION. A new idea of instructing you, with working models (from London), charts, etc., how to run and repair gasoline engines and automobiles. Send for 32-page free book, "How to Get in the Motoring Business." A. L. Dyke, Box 144, Roe Bldg., St. Louis, Mo. 12-3

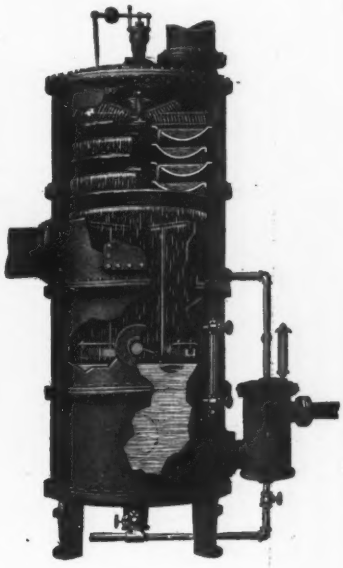
Miscellaneous

MAKE MONEY on the side. Here's your chance to pick out some money for yourself. Get subscriptions for Practical Engineer. It pays well. Just drop a line to the Subscription Dept. They will tell you how. 11-3

EVERY ENGINEER should be posted regarding the new system of vacuum heating installed without payment of royalty; I have valuable information; write to-day. T. L. Reeder, 1413 W. Jackson Blvd., Chicago, Ill.



Every Engineer And Power Plant Operator Should Read This



The types of Feed Water Heaters are legion, but many of them are merely "contraptions."

Features are added which appear to the uninitiated as good points, and the salesman makes the **most** of their "talking points" and charges accordingly. In actual service, however, many of them are not worth the space they occupy.

For instance: If Filtering Material removes **all** the impurities, what's the use of a settling chamber? The Answer is: "For settling your account for filtering material."

When you use a perforated pan, or tray, what happens? Don't the holes fill up, the same as they would in any device using water which precipitates the impurities at a high temperature? When this occurs, your areas are reduced, and you are forced to use a cold chisel, or remove the pan and punch out the accumulations. With very bad water, you wouldn't be long in hunting another position.

Then, again, when the water flows over the underside of the pan the impurities cement the pan securely in place. To then remove the pan, some Heaters are supplied with a CRANE. This is a good idea, as the task is usually TOO STRENUOUS for average power plant labor.

There are other points to be considered, but isn't the Heater for YOU, the one which is simplest in design; uses but one kind of material throughout, and which requires little attention and NO REPAIRS?

Study up the construction of the various types of heaters, and you'll soon be a **firm believer in the PITTSBURGH.**

It has none of the above disadvantages, but has many advantages not found in other heaters, and which you will find set forth in our catalog.

Better send for one today and get posted.

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PACKINGS FOR THE MOST SEVERE CONDITIONS

FIRO SUPERHEAT STEAM PACKING

CANNOT BLOW IT OUT

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STYLE-251

AS A VALVE STEM PACKING ITS UNEQUALLED QUALITY, FINEST SELECTED ASBESTOS FIBRE AND LUBRICATION MAKES IT A PEER IN ITS CLASS.

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There is a rapidly growing tendency to stop unnecessary expenditures for and a wasteful use of lubricants. The sound, new principle of Scientific Management has gained firm hold. One power plant after another, industry after industry, railroad after railroad, all are coming to realize that plain oil and plain grease are merely temporary make-shifts in the reduction of friction;

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Oildag and Gredag Are Lubricants That Afford Cumulative Benefits

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BUILDS A FILM

that is lasting. It is the only oil that contains Deflocculated Graphite. This graphite is not available in powder form. Oildag is put up in condensed form for charging one, five, ten or fifty gallons of oil. You mix it with the oil you use regularly. As all Acheson-Graphite sold as a lubricant is of highest purity, and Deflocculated Graphite is of molecular fineness, it is plain that Oildag has no equal as a lubricant to be used in place of plain oil that drips, drips and drips away without affording any benefit.

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Gredag will easily do twice the work of plain grease, because it affords a film that has wonderful endurance. The smoother you can make surfaces that come in contact, the less will be the need of lubrication, for friction will be reduced. The graphite content is the purest in the world, and wholly without the gritty impurities of natural graphite. A softer grade of Gredag can be used than of other greases, thereby greatly lessening internal friction. As the graphite used in making Gredag is a product of the highest temperature used on earth for commercial purposes, it is unaffected by temperature changes.

Remember, These Lubricants Are Based on Scientific Development

Their use will save you money, and assist to higher plant efficiency at greatly reduced cost for maintenance and operation. The services of our Lubricant Department are at your disposal to assist you in availing yourself of this possible economy. Write today. Tell your needs, and ask for Booklet 458-D.

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General Agents for Oildag and Aquadag, made by Acheson Oildag Co.

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HAS "SHOWN THE WAY"
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THE COMPOSITION OF
"RAINBOW"
AND METHOD OF MANUFACTURE, MAKES IT A PERMANENTLY STRONG, RESILIENT SOFT PACKING AND CONTINUOUSLY RESPONDS TO THE ACTION OF EXPANSION AND CONTRACTION IN THE PIPES.

THE QUALITY OF
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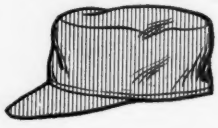

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Costs us about $2.00 a shot.

But it pays, because Keystone Grease is so much better than other lubricants that you'll never use any other when you've once tried Keystone.

KEYSTONE TRADE MARK Reg. U.S. Pat. Off. GREASE

Keystone Grease is a compound of absolutely pure, high-grade, refined petroleum—unaffected by speed or pressure — always stays "put" — cannot waste—cannot spatter and collect dust —is not soluble in water—not affected by severe atmospheric or working conditions of heat and cold — always remains the same consistency—contains no metal-eating alkali or acid—contains no resin, graphite, wax, talc or other foreign substance that would have a tendency to scratch—has an established reputation of 30 years' standing — is guaranteed to have a lower friction test than any other lubricant on the market.

ADDRESS

Keystone Lubricating Company

Philadelphia, - - Pa.

Branch offices and warehouses in the principal cities of the United States and in all the capital centers of the world.

MAIL COUPON TODAY FOR CAP, CAN AND CUP.

Keystone Lubricating Company
Department C

In accordance with your free offer, please send me an engineer's cap, a solid brass grease cup and a liberal sample can of Keystone Grease. It is thoroughly understood that no charges will be made for these articles and that all express charges will be paid by the Keystone Lubricating Company.

Firm.....

Per.....

City.....*State*.....

Name of bearing where sample will be tested.....

Its width.....*Combined H. P. of engine*.....

R. P. M......*Size of tap for cup*.....*Size of cap*.....

QUAKER CITY RUBBER COMPANY | QUAKER CITY RUBBER COMPANY | QUAKER CITY RUBBER COMPANY

Does the High Cost of Living Weigh You Down?

You cannot reduce the prices of necessities, but you can increase your earning power. Hundreds of engineers have been helped by our book of Questions and Answers to Engineers' License Examinations. We have a FREE copy for you. Do you want it?

How to Get the Hand-book FREE

Fill out the Coupon and mail it to us. We will address a book to you and send it to your dealer, who will hand it to you, FREE of charge, when you call at his store and look at Daniel's P. P. P. Packing.

YOUR NAME .....
ADDRESS .....
EMPLOYED BY .....
ADDRESS .....
HORSEPOWER OF ENGINE .....
KIND OF PACKING USED .....
DEALER'S NAME .....
ADDRESS .....
..... Series 11-L

If your dealer doesn't carry P. P. P., we will write telling you who does, and the book will be sent to the dealer we name. Please do not call for book until we notify you.

Don't Be Humbugged

There is no excuse for the mystery and confusion caused by the many strange shapes, complicated combinations, and brilliant colors of rod packings. None of these things increases the efficiency of the goods. Why spend your time trying to study out and remember the hundred and one varieties when

Daniel's P.P.P. Rod Packing

will pack anything that needs packing—engines, pumps, compressors, expansion joints, etc.? Write us, and our Packing Experts will tell you how to pack any stuffing-box in a way that will hold tight for months with but THREE rings of P. P. P.

"Regular"

THREE STYLES:
"Regular," "Special" and "Marine." All styles are furnished in Coil, Spiral and Ring forms.

FREE to Users of P.P.P.

If you are a user of P.P.P., fill out the coupon and mail it with the Big Red **D**—cut from box lid—and we will send you a FREE copy of the book, direct. You'll not be required to go to your dealer for it.

QUAKER CITY RUBBER COMPANY

MANUFACTURER OF MECHANICAL RUBBER GOODS

PHILADELPHIA CHICAGO PITTSBURGH NEW YORK

TRIPLE SHEET PACKING

THE PACKING WITH THE BLACK RUBBER BACKBONE

Because of its unusual but most logical construction, Triple Sheet Packing stands head and shoulders above **any** other rubber sheet packing, for **every** kind of service to which this type of packing is adapted:

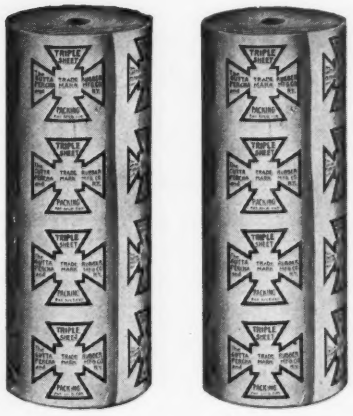
STEAM, HOT AND COLD WATER, AIR, GAS AND AMMONIA

A RED RUBBER SHEET ON THE FRONT

A RED RUBBER SHEET ON THE BACK

That "backbone" of harder rubber gives Triple Sheet Packing a body that insures it against blowing out, crawling, becoming soft, melting or oozing out of the joint.

In fact, it is not too much to say that Triple Sheet Packing will put an end to the packing troubles which almost every Engineer has had so long as to feel that they are practically unavoidable.



There is nothing new about this argument — these promises. The thing that's new is the perfect, **absolute** performance that is back of them, in Triple Sheet Packing.

You need no more than **see** Triple Sheet Packing to feel that our statements about it are true. And a **trial** will **prove** to you that "Triple Sheet" is **the** packing for **long, economical service.**

USE THE COUPON

below, or a postal card, get the Free Sample and see how it looks to **you.** Use your knife on it and see what's **inside** of it.

Do this NOW and side-step your packing troubles.

ONLY THE GENUINE BEARS OUR TRADE-MARK

THIS TRADE-MARK IS YOUR PROTECTION

TRIPLE SHEET PACKING IS MANUFACTURED ONLY BY

THE GUTTA PERCHA AND RUBBER MFG. COMPANY

CHURCH AND DUANE STREETS

NEW YORK, N. Y.

STORES: CHICAGO, 301 West Randolph Street
SAN FRANCISCO, 34 Fremont Street
PHILADELPHIA, 221 Chestnut Street
BOSTON, 71 Pearl Street

Gutta Percha and Rubber Mfg. Company, New York.

Gentlemen: Please send to me, at once, Free Sample of TRIPLE SHEET PACKING.

NAME .....

ADDRESS .....

.....

Rainbow Friction Surface Rubber Belting—the belt you need for heavy transmission work. Because of its flexibility and strength it is the best and most economical for extremely difficult service. It is especially adapted for high speed and for use on small pulleys. Every belt is stretched by a patent method and has a guaranteed friction test of 22 lbs.

When ordering hose, be sure you get **Perfected Hose.** It is guaranteed to be the best in the world and will last two or three times as long as the ordinary kind.

PERFECTED HOSE

is constructed with a braided jacket under outside cover, which greatly increases its pressure capacity and yet does not make it cumbersome. Made for **water, steam, air** and **all difficult services.** Mildew or dampness will not cause it to deteriorate. Try it and you'll be a permanent user.

Length of Service and Efficiency determine the quality of a packing. **Rainbow** is the most durable, effective, and economical packing made. However rough the surfaces of the flange may be, **Rainbow** will make a tight joint that will hold the highest pressures. When once put in the joint it stays there —will not burn, harden, crack, or blow out. Joints on steam, oil, air, water, or ammonia connections made equally efficient. As **Rainbow does not** harden under any degree of heat, no tools are necessary to break or face off a joint where it is used. Connections can be made and broken in one-eighth the time required with packings that harden. **Rainbow** can be taken out and repeatedly replaced for it retains its efficiency long after others have been thrown aside. Specify it in your next order.

We are western distributors for **Peerless Rubber Mfg. Co.,** and carry a complete line of their products—Rainbow, Peerless, and Eclipse Packings, Rainbow Belting and Perfected Hose. Prompt delivery from either our Chicago or Denver Stores.

GEO·B·CARPENTER & Co.

CHICAGO
200-208 South Water Street

DENVER
1556 Wazee Street

WE DON'T BLAME YOU

for not ordering a packing you haven't seen, but it's your own fault if you don't **TRY** to get the **BEST** that is made.

We make strong claims for **Kerbaux Rod Packing,** and we make good our claims, but don't take the optimistic words of an advertisement as being gospel truth.

Send for a sample and see for yourself if

KERBAUX

ROD PACKING

1st, is not the best and most scientifically lubricated packing you ever saw.
2nd. If its mechanical structure isn't designed to stand the highest pressures.
3rd.. If there is anything to harden or deteriorate in stock.
4th. If you have seen a more flexible or resilient packing.
5th. If there is any reason you can't use it on intermediate and low pressures, as well as the highest.

"'Price,' you say?" "You're wrong."

KERBAUX COMPANY, 114 Liberty Street, New York.

Gentlemen: Please send me free sample and quote price of KERBAUX ROD PACKING.

Name .....
Address .....
Firm's Name .....

VANDA

SHEET

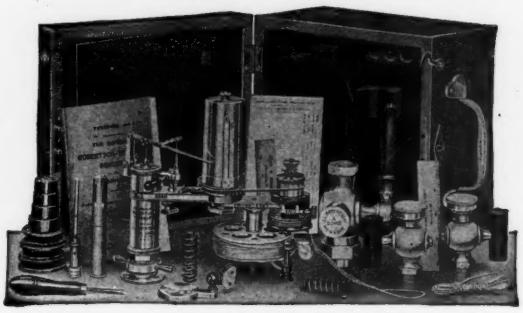
VANDA
A STEAM PACKING THAT IS A STEAM PACKING
TRADE MARK
REG. IN U.S. PATENT OFF.

PACKING

VANDA

THE VANDA CO., —96— SPRING ST. NEW YORK

A RADICAL CHANGE



Experience shows us that an installment business conducted on the square is to the positive disadvantage of a manufacturer. For that reason and because we want to do a larger business, we have DISCONTINUED selling on installments and hereafter give to those who will pay cash all the benefits of a cash business and a large portion of our profit.

Accordingly we now offer you

The Robertson-Thompson Outfit including the Victor Reducing Wheel

FOR CASH at a price never before approached. The instruments will be equal in every respect if not better than heretofore and carry the same strong guarantee. Outfit will consist of a Robertson-Thompson Indicator and Victor Reducing Wheel, packed in a handsome hardwood case; with lock and key, nickel-plated trimmings, fitted with extra ¼" piston, detent motion, two springs, as selected, either one three-way or two straightway cocks, scales, cord, oiler, book of instructions, etc.

THE WILLIS PLANIMETER—The finest instrument made at an equally low price for cash.

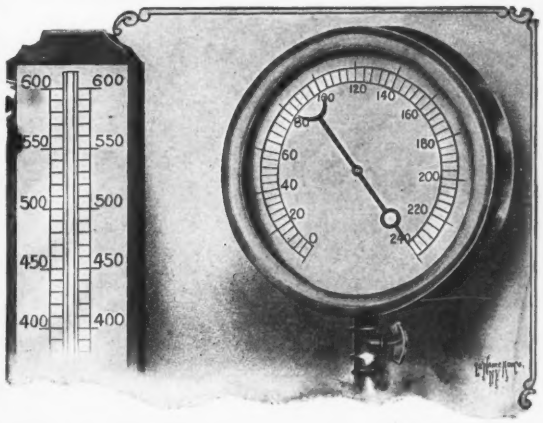
Terms—Cash with order or an advance payment of $3 as an evidence of good faith—the balance C. O. D. with privilege of 5 days examination at express office. If instruments are not as represented we will pay return charges and refund the money.

Send for catalog and special cash price.

Jas. L. Robertson & Sons

Jas. L. Robertson, Pres.

74-76 Murray Street, New York City



"Ambest" Lubricated Metallic Packing

A fair square marker of the value of Ambest as a packing is time, and time alone can tell in its fullness the betterness of Ambest for all packing purposes.

Ambest is the least troublesome, the longest wearing, the most satisfaction giving packing you could use on any valve, valve stem, engine and pump rod in your plant.

It will not corrode, fuse or grow hard under high pressure and temperature, or any other condition.

It will not scratch, score or harm a rod and it will maintain unfailingly tight joints and easy working rods.

Once in a stuffing box it will last indefinitely long by simply adding a little more as gradual wear demands it.

It need never be removed from a stuffing box but, if occasion requires removal, it can be done easily with a packing hook, it does not have to be chipped out, and after removal it can again be applied, and it will give the same full measure of service and satisfaction.

To know this, fill out coupon and send for Free Working Sample to test—as you please.

Eureka Packing Co., N. Y. **P.E.**

You may send me Free Working Sample of
"AMBEST" METALLIC PACKING

Name .....

Address .....

Firm's Name .....

NOTICE

We also manufacture the old and very popular

Empire
Round Gum Core
Packing

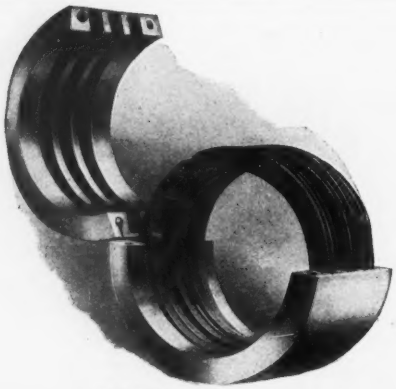
formerly made by the

Canfield Mfg. Company of Philadelphia

EUREKA PACKING CO.

Jas. L. Robertson, Pres.

74-76 Murray Street New York City



Inside Split Case Type

FRANCE METAL PACKINGS

(MADE OF VANADIUM CAST IRON)

Are Made To Meet Every Condition In Your Plant. Every Set Guaranteed.

WE WILL SELL YOU THE PACKING OR RENT IT AT SO MUCH PER YEAR
Send for details

Send for our new Catalogue

FRANCE PACKING CO.
Tacony, PHILADELPHIA, PA.
Branch offices in every large city

Self-Lubricating, Frictionless

In Cans
6, 12, 25 and 50 Lbs.

Highest Award World's Fair, St. Louis

"SAFETY" PLASTIC

METALLIC PACKING

FOR STEAM, WATER, AIR, GAS, ETC.

Guaranteed to stand steam temperature to 550 deg. Fahr. and hydraulic pressure to 5,000 lbs. per sq. inch. Packing furnished in bulk and in Thin Cotton Tubes, size 3-16 to 1½ in., 36 in. long, or in lengths to fit your stuffing boxes. Empty Cotton Tubing in assorted sizes **FREE OF CHARGE** with orders for packing in bulk form. The tubes are easily filled.

Any quantity sent on approval.

Send for **FREE SAMPLE.**

STEEL MILL PACKING CO., Detroit, Mich. U. S. A.

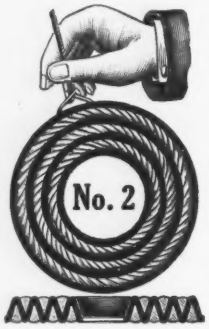
THE USE OF TRIPLE GASKETS WILL MAKE ALL JOINTS EQUALLY EFFICIENT.

Asbestos or Rubber enclosed.

There will not be a leaky, troublesome joint in your plant. They will be a thing of the past. Simply use Triple Gaskets in making the joints tight and the result will be absolute satisfaction. **Vibration** of the pipe line cannot affect their efficiency. They "stay put" and "come and go" with the piping. They are made of the best asbestos or rubber encased in a copper sheath and do not break when taking joint apart, hence they can be reapplied again and again. Reduction of gasket expense and better service can only arise from their use. **We make gaskets for all purposes.**

Ask for Booklets.

Cincinnati Gasket & Packing Co., 1536-1538-1540-1542 Plum St., Cincinnati, Ohio



Copper

Your Orders and Specification must call for Genuine

GOETZE

NUMBER TWO GASKETS

Steel

Only the best things are imitated. For your own good, do not be deceived by imitations of this obviously superior Gasket, no matter what claims may be made for them. "Just as good" is an unwitting acknowledgement that Goetze's Gaskets are the standard by which other gaskets are measured. When you want this Gasket order Genuine Goetze Elastic Corrugated Copper Gasket with Asbestos Lining No. 2. There is nothing "just as good."

Our five years' Guaranty stands for Service, Durability, Economy.

Can you get anything better?

Or as good?

Genuine Goetze's No. 2 Gaskets on 90 days' trial, to be paid for only if they make good in your plant! Try them.

Goetze Gasket & Packing Company

17 Allen Avenue, New Brunswick, N. J.

J-M Kearsarge Jointless Gaskets
Removed and Replaced Over 65 Times

Illustration shows one of 160 J-M Kearsarge Jointless Gaskets that were removed and replaced every two weeks, or **over 65 times,** during the two and one-half years they were in use on boiler plates in plant of the Public Service Board, Conneaut, Ohio. At the end of this time these gaskets were found to be in such good condition that they were again put in service.

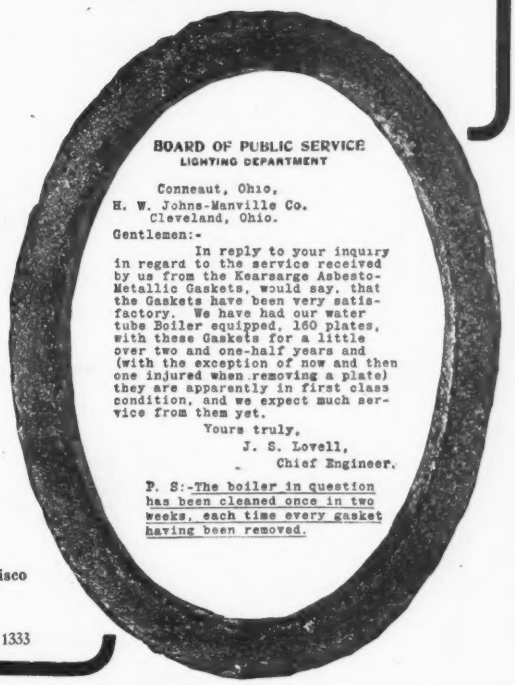
You can get this kind of service only by using J-M Kearsarge Jointless Gaskets. They withstand the highest steam pressures, and will not blow out, pull apart, char, disintegrate, or harden.

Are made in one piece of endless circular strips of Asbesto-Metallic Cloth (cloth woven from pure, long-fibred asbestos, with fine brass wires twisted in each strand,) double folded and cemented together with J-M Heat-Resisting Compound. Have no taped joints, therefore, no weak points.

J-M Kearsarge Jointless Gaskets are 25% lighter in weight than any other Asbestos Gasket, so cost less.

If you wish to avoid gasket troubles and expense of frequently renewing, try J-M Kearsarge.

Ask our nearest Branch for Sample and Booklet.



BOARD OF PUBLIC SERVICE
LIGHTING DEPARTMENT

Conneaut, Ohio,
H. W. Johns-Manville Co.
Cleveland, Ohio.

Gentlemen:-

In reply to your inquiry in regard to the service received by us from the Kearsarge Asbesto-Metallic Gaskets, would say, that the Gaskets have been very satisfactory. We have had our water tube Boiler equipped, 160 plates, with these Gaskets for a little over two and one-half years and (with the exception of now and then one injured when removing a plate) they are apparently in first class condition, and we expect much service from them yet.

Yours truly,
J. S. Lovell,
Chief Engineer.

P. S:-The boiler in question has been cleaned once in two weeks, each time every gasket having been removed.

H. W. JOHNS-MANVILLE CO.

Manufacturers of Asbestos and Magnesia Products. ASBESTOS Asbestos Roofings, Packings, Electrical Supplies, Etc.

Baltimore	Cleveland	Kansas City	Minneapolis	Omaha	San Francisco
Boston	Dallas	Los Angeles	New Orleans	Philadelphia	Seattle
Chicago	Detroit	Milwaukee	New York	Pittsburgh	St. Louis

For Canada—THE CANADIAN H. W. JOHNS-MANVILLE CO., LIMITED,
Toronto, Ont., Montreal, Que., Winnipeg, Man., Vancouver, B. C. 1333

VELLUMOID

The packing that will not deteriorate under any condition of service.

It not only resists the action of vapor and liquids, but actually becomes strengthened by contact with moisture.

Somewhere about your plant there is one troublesome joint more aggravating than all the rest—always putting in the hurry call for "help" at the unexpected time.

This is the place VELLUMOID is looking for—to convince you that your packing troubles are at an end.

Your request for free samples of SHEET PACKING or a trial Gasket cut to any size will have our prompt attention.

NEWTON MANUFACTURING CO.
WORCESTER, MASS.

MR. ENGINEER:

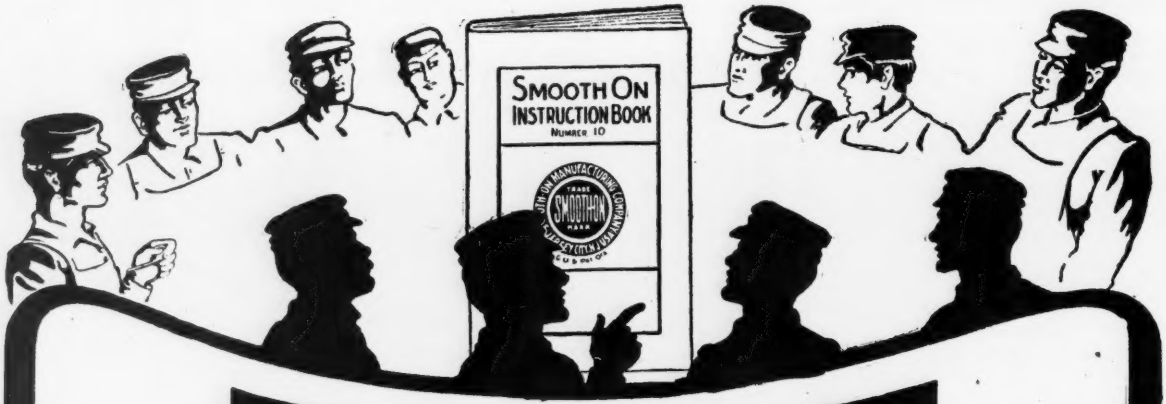
We wish to thank you for your generous support during this year, and we

Wish You A Merry Christmas and A Happy New Year

We shall continue to do the very best we can, in our efforts to reduce your work, and by reducing your cost of maintenance, help to get you more salary.

FEDERALITE

Made by
FEDERAL METALLIC PACKING CO.
BOSTON, MASS.



FREE
INSTRUCTION BOOK

Send for it today.

This book should be within instant reach of every engineer. It tells clearly, by photograph and formula, how to use the well-known Smooth-On Iron Cements in repairing boilers, engines, castings, tanks, joints, etc.

Used according to instructions, Smooth-On Cements will save more actual time and money in the engine and boiler room than any single product manufactured. Their uses are innumerable, and its repairs absolutely permanent.

Smooth-On Mfg. Co.

572-574 Communipaw Ave.
Jersey City, N. J.

Chicago, 231 North Jefferson Street

San Francisco, 94 Market Street

London, 8 White Street, Moorfields, E. C.

INEXCUSABLE

IT IS NOT NECESSARY TO HAVE HOT BOXES OR TO BE REBABBITTING BEARINGS EVERY FEW MONTHS. THE FOLLOWING LETTER IS MERELY ONE AMONG THOUSANDS. WHY NOT INSIST UPON HAVING MAGNOLIA; IT WILL SHOW A BIG SAVING ALL ALONG THE LINE.

Philadelphia, Pa., Jan. 2nd, 1911.

Dears Sirs:

I will tell you about the use I have put Magnolia to. I poured three bearings on Jack Shaft that were always hot and could not lay your hand on. I put Magnolia in and the bearings are now running fine and are about 100 degrees warm—there was White Brass in them before. I poured a top bearing block on a 300 H. P. Corliss Engine that could never be kept cool: no more trouble. This was done five months ago. Four months ago I poured a main bearing on a 250 H. P. Griene Engine top, bottom and quarter blocks, started the Engine up, it never got hot: Engine runs twenty-three hours a day. I had trouble with Motor bearings; had to fix them every couple of months, they had white brass in before, changed them all to Magnolia, have not had any trouble since. This was one year ago. I have used it on Crank pin bearings and find it fine. I hope this is good news for you.

Yours truly,

Charles E. Reber,

Foreman Machine Shops & Repairs, Camden Coke Co., Camden, N. J.

SOLD BY LEADING DEALERS EVERYWHERE OR BY

MAGNOLIA METAL CO.

New York 114 Bank Street
Chicago Fisher Building
Montreal 225 St. Ambroise Street

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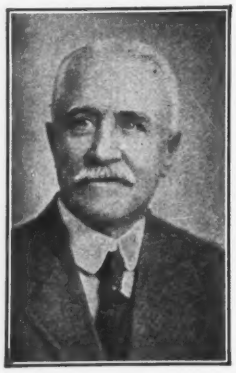
PRACTICAL ENGINEER POCKET BOOK: 700 pages; over 2000 subjects. Price, 40c, postpaid. We do not aim to make a profit on these books: we buy them in large quantities as an advertising medium, and give engineers benefit of low price. They are highly spoken of by Engineers. Address New York Office.

The "Eureka" Square Deal

Published in the Interests of Honesty in the Packing Business

By James L. Robertson

Two Sides to the Graft Question



JAS. L. ROBERTSON

The more I ponder over this graft question, the more I wonder that a single member of the engineering profession can risk his future and his profession's future by dealing in any instance with a graft-offering manufacturer.

Look upon the two sides of graft.

Yours is truly a great industry. Back of every great enterprise is a power plant. Nothing can be manufactured, no wheel turns in all the world without power. Into the hands of engineers and upon their shoulders are thrust tremendous responsibilities. There is the great responsibility of human life. There is the momentous responsibility of efficiency. There is the responsibility of the invested dollar which must earn its way.

This profession is in the process of evolution. Out of fog and darkness employers, managers of enterprises, are just beginning to see that efficient power cheaply produced is the groundwork of a successful business.

And so they are forced into a recognition and respect they have never felt before, and are destined to feel more certainly as time passes.

Into this picture inject the crooked manufacturer. I don't care whether he sells packing or prime movers—his influence is the same.

He comes into what is normally a clean, square, independent business with his slimy, underhand methods, corrupts a few of its members and holds the whole profession back. Nothing spreads faster than a bad reputation. If there are 100,000 engineers in the country and only 100 of them fall into the bribing manufacturer's trap, all of the balance—the square and honest balance—are looked upon askance by their employers.

It is not fair, it is not just, but it **is**—you can't get away from the facts.

On one side, then, is the glowing picture of a greater future for engineering and engineers, and on the other the impediments put in the way of a quick realization of hopes by the dirty methods of the bribing manufacturer.

What's the answer? Just this: Every time you hear of an engineer who "takes his," convert him.

Every time you are in the slightest way approached by a bribe-offerer, turn him down—not mildly, but so hard that he'll think he has hit the place that never freezes over.

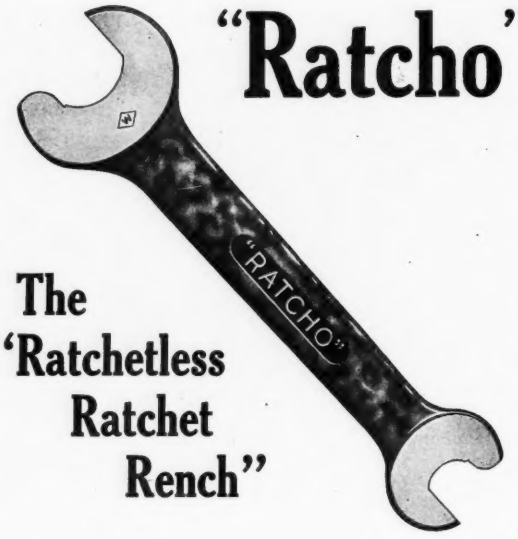
Then take the facts to headquarters. Explain exactly what happened, and tell them you don't want a representative of that concern inside your office again. Blacklist 'em, and, believe me, you'll hand this graft-game a blow it will never recover from. Every time you make that move you'll put the engineering profession one step nearer its ultimate goal.

Eureka Packing is one of the brands that is sold on a "square deal" basis and in no other way. If your dealer hasn't got it in stock and can't supply it, send to us direct. We'll pay freight on 10 lbs. and over east or south of Omaha. We make 39 varieties for all purposes and the line comprises all styles and shapes.

Eureka Packing—39 Varieties—Have You a Catalog?

Eureka Packing Company
James L. Robertson, President
74-76 Murray Street, New York

"Ratcho"



The "Ratchetless Ratchet Rench"

Send for free sample and try it on the nut. Use the tool exactly as you do a ratchet and see the surprising simplicity of an ingenious form of Williams' milling which releases the tool from the sides of a nut or screw automatically and instantly regrips them when the handle of wrench is drawn toward you. To release a nut or screw simply turn tool over and use in same way.

"Ratcho" wrenches have thrice the efficiency of ordinary Drop-forged wrenches.

Get Convenience
Efficiency
Speed

at same price as you pay for ordinary tools.

"Anything" in Williams'· Wrenches has Superiority.

For sale by dealers

J. H. Williams & Co.
Superior Drop-Forgings
81 Richards Street
BROOKLYN, N. Y.

"Ratcho" six set has capacity of 15 millings in six wrenches, seven most important bolts (¼ to ⅜) and eight most important cap screws (¼ to 1)

NO OTHER INDICATOR WOULD DO THIS

3,691,760 STROKES

STILL IN FINE ORDER. 116 YEARS AVERAGE USE

On May 6, 1906, Mr. Wm. V. Barr started a Lippincott indicator for a week's run on his high speed engine. This instrument made **one million five hundred and ninety-three thousand seven hundred and sixty strokes**, and was then **as good as new.** On September 6, 1911, Mr. Barr commenced another test with the above indicator, without any repairs having been made, and in this test it made over **two million, ninety-eight thousand strokes more, and is still in perfect condition. A micrometer showed that the piston was exactly the same diameter as at the start.** Next time we expect to wear it out.

WILL YOU INVEST A FEW MINUTES A DAY AND A FEW $$$ A MONTH TO GET MORE DOLLARS A WEEK?

IF YOU WILL HERE'S YOUR CHANCE

Everybody knows that the engineer who owns a good Indicator, and knows how to use it, stands way up at the head of the **"MORE MONEY LINE,"** while the one without such equipment, is not even in the line! **LIPPINCOTT INDICATORS** are better designed, more accurate, more durable, that any other. Every well informed engineer knows this; also, that the Lippincott Course teaches thoroughly, and in an easy way, everything the engineer needs to know about the **INDICATOR**—how to get the most out of it, how to get the most **DOLLARS** for his work! **NOW THEN, HERE'S YOUR OPPORTUNITY**—to get the best Indicator, and the **ONLY** systematic Course of Instruction, with the privilege of taking your indicator troubles to an expert, for "cigar money,"

INDICATOR INSTRUCTION BY MAIL!

EVERY STUDENT IS LOANED A NEW, LATEST PATTERN LIPPINCOTT INDICATOR, and when the course is completed, and paid for, this indicator becomes his property, without another cent of cost. **(NOT MORE THAN 100 SCHOLARSHIPS ISSUED PER MONTH.)**

$1.00 A Week

DISTANCE NO BAR!

No matter where you are, we can reach you, and teach you. If you have a good education, so much the better, but if you can only read and write, we can teach you.

We have taught thousands of engineers in U. S., Canada, Mexico, Alaska, Australia, India, South Africa and Hawaii, and they get better jobs, because they KNOW what others guess at.

DOES ANYBODY BUY 'EM?

We will gladly send certified express receipt of Wells Fargo Co. covering this shipment .

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36 IN ONE DAY

IT HAS EVERY IMPROVEMENT

A LIPPINCOTT WILL OUTWEAR 25 OF ANY OTHER MAKE

DONT BE ASHAMED TO COME TO US FOR INSTRUCTIONS. We have taught eminent consulting engineers, chief engineers of large stations and professors. However, if you wish, we will keep it confidential.

IF YOU THINK WE CAN'T TEACH YOU, SEND FOR "TEN SIMPLE INDICATOR QUESTIONS," and see how many you can answer correctly! Write quickly, as there are only a few left.

WE WILL PAY YOU A SALARY TO SELL OUR INDICATOR

and instruct engineers in its use. You probably know, right NOW, some engineers who would buy, if you would show them how much better the LIPPINCOTT is than any other. If you only sell ONE, we will make it worth while; if you show ability you can get a good salary every week: You would be proud to sell

THE "INSTRUMENT OF THE CONSULTING ENGINEER"
the "LIPPINCOTT"

Now take a postal card, write on the back of it your name, address, and what you want—catalog of Indicator, Reducing Wheel, Planimeter, Mail Course or 10 Questions. Address it to

WHY?

Better material, design and workmanship; live steam jacket; two cylinders and pistons, ¼ and ½ inch, with each indicator; Lippincott patent frictionless "FLOATING PISTON" (GLASS HARD STEEL) with "tail-rod"; friction and wear eliminated! We make the only absolutely correct spring—Strange, but true!

LIPPINCOTT STEAM SPECIALTY AND SUPPLY CO., 50-60 COLUMBIA STREET, NEWARK, NEW JERSEY

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Stephenson Bar Belt Dressing

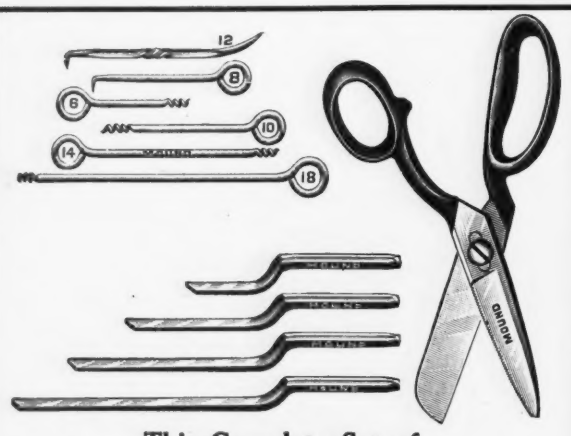
Vacation time is over. You must think about Fall and the long Winter months. Many new mills, machine shops and power plants will begin running this month. Many chief engineers will buy their equipment for the coming season.

None Genuine without this Trade-Mark

None Genuine without this Trade-Mark

This Dressing, which has been on the market for nearly twenty-five years, must be among the items which you will need for your shop this Fall and Winter. It is a standard article and absolutely does the work required. It not only satisfies your immediate want, but materially prolongs the life of your belt. If you are undecided, WRITE for a free half pound sample of either RED label for leather belts or GREEN label for rubber, canvas or balata belts.

Stephenson Manufacturing Company
Albany, New York



This Complete Set of

Mound Packing Tools

Consists of four packing irons, for placing packing in stuffing boxes, six special tools for removing packing and a pair of packing shears which will cut any fibre, sheet or leather packing. All of these tools are forged from best tool steel and are fully guaranteed. At retail, these tools would cost you $5.50. On our time payment plan *you get them for $5.00 if you send the coupon.*

COUPON.

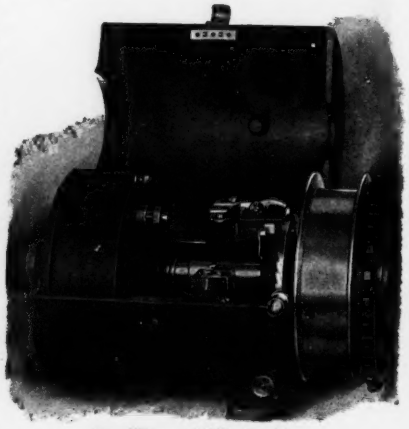
Mound Tool & Scraper Co., 7th and Hickory Sts., St. Louis, Mo.
Gentlemen:—Enclosed find one ($1.00) Dollar for which send me one Combination Packing Tool Set, price $5.00, and I hereby agree to remit balance ($4.00), in three payments within ninety days from date.

Name..... Date.....

City..... State.....

Get on the Safe Side

by installing any one of our Engine-Stop and Speed-Limiting Devices. That is the one *sure* way to *prevent* fly-wheel accidents. Engine accidents outnumber boiler explosions four to one.



The "Monarch" Engine Stop

The Monarch Engine-Stop and Speed Limit Systems embrace the devices that will best meet the conditions in *your* plant, for we make every *good type*. When you have gone into the subject with our Engineering Department, and they have advised you without charge which type of Engine-Stop is best suited for your particular needs,

Remember That We Are Prepared to Install It on 60 Days' Trial

Write our Engineering Department, *today*, what your Engine equipment is and we'll gladly send you complete information.

Consolidated Engine Stop Company
The Only Exclusive Manufacturers of Engine Stops
351 W. 38th St., New York City

Try it on the Worst Joint in Your Plant At Our Expense

HOW much time have you wasted following up packing, especially in those hard-to-get-at places? How many times have you had trouble on account of packing blowing, squeezing or burning out? Think what J-M Permanite Packing, with none of these shortcomings, would mean to you.

J-M Permanite is made differently from other packings. It isn't rubber. Yet it possesses the two features which are the only excuse for the existence of rubber packings—resiliency and pliability.

J-M PERMANITE SHEET PACKING

has heat and pressure-resisting qualities because made of the finest grade of long-fibred Asbestos. It will make tight joints under all conditions.

Being one of the lightest packings made, its price, comparatively, is very low, which makes it the most economical packing to use.

All these features make J-M Permanite splendidly adapted for superheated and high pressure service, as well as for low pressures in cylinders and steam chests, and for ammonia lines, acids, alkali and sugar solutions.

We'll send you, without charge, enough of this packing to try in the one place in your plant *where no other packing has ever made good.*

Write nearest Branch to-day for Sample and Booklet.

H. W. JOHNS-MANVILLE CO.

Manufacturers of Asbestos and Magnesia Products. ASBESTOS Asbestos Roofings. Packings. Electrical Supplies. Etc.

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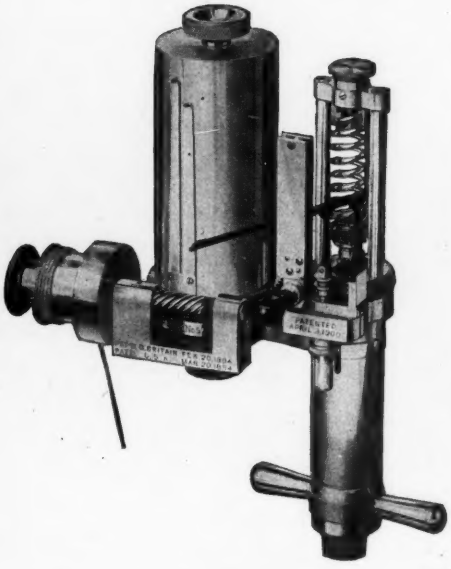
HOW ABOUT YOUR PLANT?



ARE **YOU** RUNNING IT **ECONOMICALLY?**

ARE **YOU SHOWING A SAVING** OR CAN THE **OTHER FELLOW** GIVE **BETTER** AND **CHEAPER SERVICE?**

ARE YOUR ENGINES **STEAM-EATERS** OR ARE THE VALVES SET FOR **EFFICIENCY** AND **ECONOMY?**

PROPERLY SET VALVES AND SMOOTH RUNNING ENGINES WILL RESULT IN A GREAT **SAVING IN** THE **STEAM CONSUMPTION.**

A **RELIABLE, ACCURATE** AND **DURABLE** STEAM ENGINE INDICATOR WILL SHOW THE CONDITION OF YOUR ENGINE **VALVES,** WILL LOCATE **LEAKS** AND WILL **INDICATE** WHETHER **THE ENGINE** IS RUNNING PROPERLY OR NOT.

TABOR INDICATORS

ARE SHOWING GREATER RETURNS THAN ANY OTHER SINGLE PIECE OF POWER PLANT EQUIPMENT. THEY ARE **"HOLDING JOBS"** AND MOVING MEN INTO THE **"JOBS HIGHER UP."** **NOW** IS THE **TIME** FOR THE **ENGINEER** TO **SHOW RESULTS.**

THINK THIS OVER — THEN **SEND** THE CORNER COUPON FOR INFORMATION ON OUR SPECIAL INDICATOR SCHEME.

DO IT—TODAY.

The Ashcroft Manufacturing Co.
85 Liberty Street, New York (P)

Please send me your special proposition on Tabor Indicators.

Name .....
Address .....
City .....
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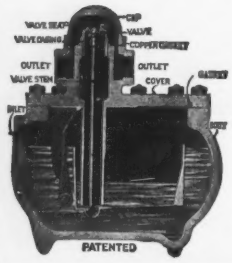
THE ASHCROFT MANUFACTURING COMPANY

85-87-89 Liberty Street, NEW YORK

111-115 North Canal Street, CHICAGO

The Squires Steam Traps

For SERVICE



Let us send you one or more Traps subject to your approval.

Write for Catalog E-9

THE C. E. SQUIRES CO.,

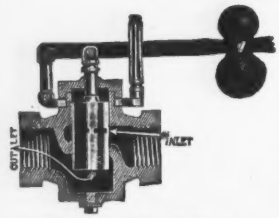
Manufacturers of Steam Specialties

East 40th Street and Kelley Ave., CLEVELAND, OHIO

Branch Office:
1135 Park Row Bldg.
New York City.

WATSON REDUCING VALVE

WITH LEVER AND WEIGHT



Send for Complete Catalogue

This Valve is metal throughout all its parts, nothing complicated. It will outlast any other Reducing Valve made.

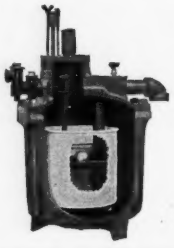
Should be used on heating system or anything requiring a steady reduced pressure; the valve will adjust itself to feed in just enough steam to keep up the pressure wanted.

We also manufacture Steam Traps, Exhaust Heads, Separators, Pump Governors and Blow-Off Valves.

WATSON & McDANIEL CO.

148 North 7th Street PHILADELPHIA, PA.

Class "A" Albany Return Steam Trap



Most practical and efficient Steam Trap on the market.

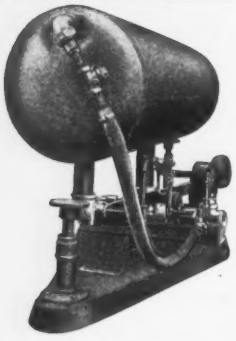
We are the originators of the Return Steam Trap and have been making and selling them for over 40 YEARS. It is no experiment with us. No stuffing-boxes to stick or leak steam, all joints faced metal to metal.

Will remove the condensation from heating systems, dry-rooms, kilns, jacketed cylinders, separators, etc., and return the water directly into the boiler.

If in need of Steam Traps, or have troubles with them—

WRITE US AND WE WILL HELP YOU.

ALBANY STEAM TRAP CO. Established 1870 **ALBANY, N. Y.**



The Morehead Condenser Trap makes its own Vacuum

and PULLS the accumulated water and air out of your steam lines, insuring rapid circulation. Enables you to cut down your boiler pressure on direct heating systems.

Particularly adapted for use in connection with reduced pressure and Exhaust Steam Heating Systems, Dry Kilns, Dryers, Fan Stacks, Etc.

Write for Particulars and Trial Trap.

Morehead Mfg. Co.

Condensation Dept.

Detroit, Mich.

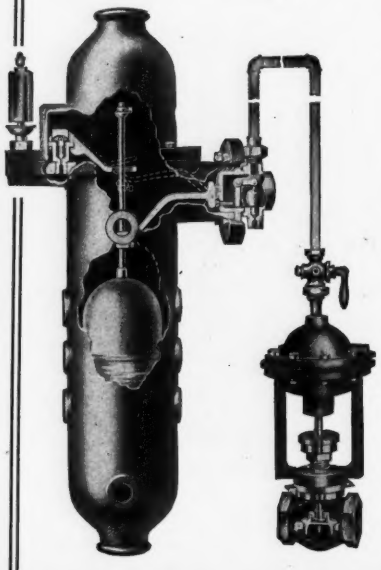
STOCKS CARRIED IN

New York Philadelphia Chicago San Francisco Los Angeles
Wichita, Kan. Memphis, Tenn. New Orleans, La.
Birmingham, Ala. Chatham, Ala.

BEFORE IT IS TOO LATE

Save yourself a great deal of trouble and expense by connecting the **Williams Improved Safety Feed Water Regulator** to your boilers.

Don't wait until you have permanently injured the boiler and other parts of your equipment by the irregular feeding of the water supply.



Don't wait until the boiler has blown up and destroyed life and property.

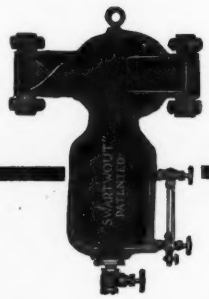
Get the **Williams Regulator** and avoid these troubles.

It is as necessary to the boiler as the coal is to the furnace. You want perfect regulation and you most certainly want the **Williams Regulator.**

So we repeat—before it is too late, get the **Williams Regulator**—it is the only one sufficiently reliable to be entrusted with the regulation of your feed water.

You need our literature—it not only describes our regulators, but tells about the **Williams Steam Traps, Pump Governors, etc.**

The Williams Gauge Co., 643 Fourth Ave., Pittsburgh, Pa.



Without a baffle-plate or other obstruction, without reducing the pressure in the least, the

"SWARTWOUT" STEAM SEPARATOR

takes out every bit of the water, and the steam flows on at full pressure.

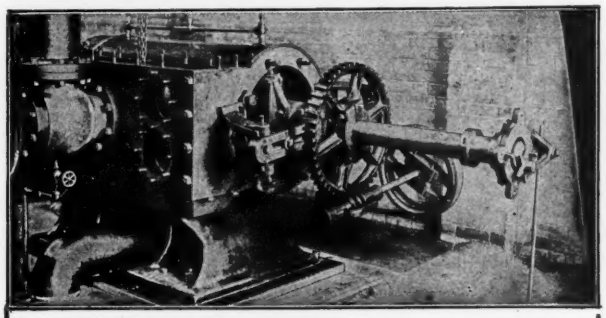
CENTRIFUGAL FORCE DOES IT.

The Ohio Blower Company

Automatic Safety Water Gauges
Cast Iron Exhaust Heads
Rotary Ball-Bearing Ventilators

330 Michigan Street, Cleveland, Ohio

Representatives in All Large Cities 1-146



Lee's (Patented) Improved Portable Boring Tool in Position

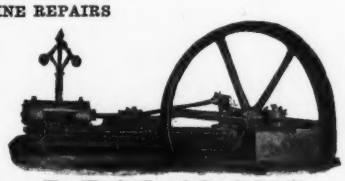
WE TAKE THE TOOLS TO THE JOB
wherever it may be, repair your engine right where it stands and cut hours off from those shut-down periods where minutes are dollars to you.

OUR ENGINE REPAIR SERVICE
is an organized service that includes not only the best tools and methods, but men who "know how." Remember this service in your next engine emergency and save. You can't beat

ST. JOHN SELF-ADJUSTING CYLINDER PACKING
at any price, and we don't believe you can match

OUR PRICE—$5.00 PER INCH.
That's anywhere from $1.00 to $3.00 per inch under the market.

WHEN YOU NEED ENGINE REPAIRS
for Hartford, Buckeye or Woodruff and Beach Engines, it will pay you to remember that we have the drawings and patterns and keep a line of repairs on hand, finished and partly finished.



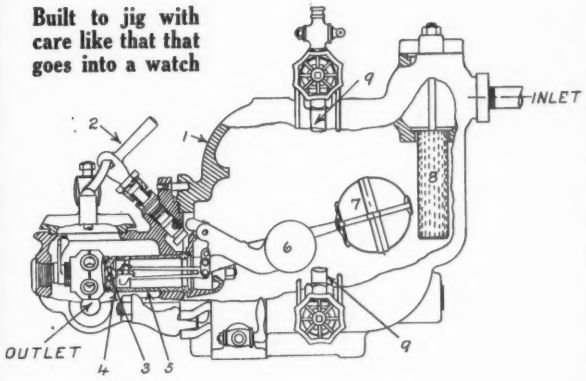
The Woodruff and Beach Engine

HARTFORD ENGINE WORKS, Hartford, Conn.
Successors to HARTFORD ENGINEERING CO.
Builders of the Improved Hartford Buckeye Engines.

Drawing of

Anderson Model "D" Trap

Built to jig with care like that that goes into a watch



Showing a Few Things to Notice About Anderson Trap Construction:

1. Note thickness of shell.
2. By-pass—hand operating.
3. Big ample valve and
4. Clean, snug, water-sealed seat.
5. Heavy valve seat ring.
6. Counter weight.
7. Anderson spun-copper float.
8. Strainer through which all water passes.
9. Water-glass showing operating conditions at a glance.

Every Engineer should have our Trap Book. Sent on request. Put your condensation troubles up to us. Write for copy today.

THE V. D. ANDERSON CO.

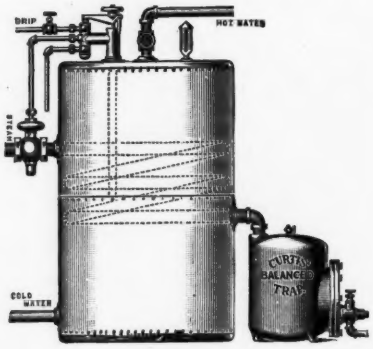
1937 West 96th Street CLEVELAND, OHIO

3 of the CURTIS ENGINEERING SPECIALTIES

4 INCH

Four-inch Ballcock; furnished complete with copper float.

Water Pressure Regulator for pulp and paper mills.



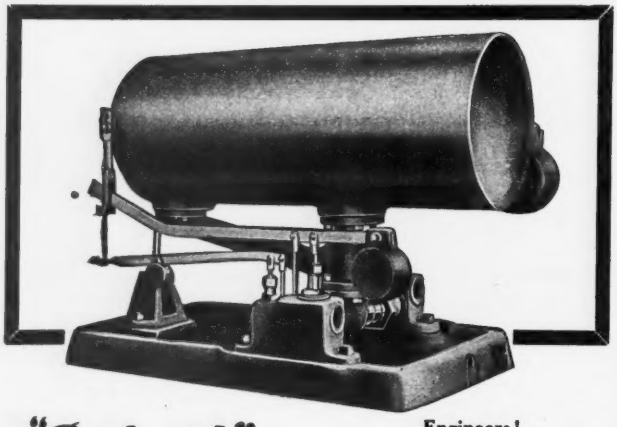
For controlling the temperature of hot water in hotels, hospitals, etc.

SEND FOR CIRCULARS AND 1911 CATALOGUE

JULIAN D'ESTE COMPANY,

24 Canal Street
Boston, Mass.

New York Agents:
BOIG & HILL
216 Fulton St., N.Y.



"Detroit" RETURN TRAPS
1911 Model

Engineers!
We want you to know this trap—why it saves you work and annoyance, and gives you more time to yourselves.

***are an investment*—not an expense.**

The dividend **comes in the form of *coal saving*, steam saving, increased boiler efficiency, increased efficiency of heating and drying systems, low water rate.**

Why?

Because 'Detroit' Return Traps automatically drain every drop of condensation from whatever source and return it directly to boiler without pumping, at practically the same temperature at which it is condensed.

No system is too large nor too small to be benefitted by the use of 'Detroit' Traps. Bulletin No. 320. PE.

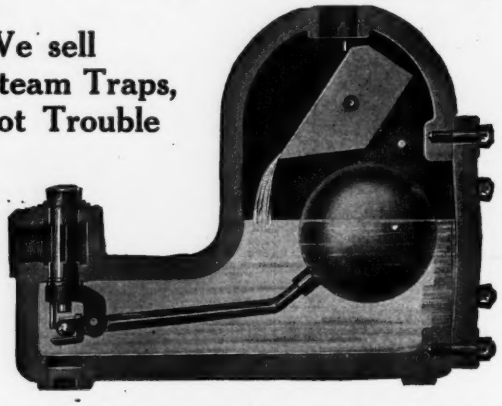
AMERICAN BLOWER COMPANY
DETROIT, MICH.
U. S. A.

LOOKING FOR TROUBLE?

If you are, don't use a

Nason-Vesuvius Steam Trap

We sell Steam Traps, not Trouble

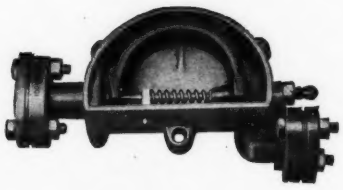


With the Regrinding Ball Valve, the Intermittent Discharge, the Large Discharge Orifice and Other Distinctive Features, the Nason-Vesuvius eliminates all the usual steam trap troubles. The infrequent renewal, the ready removal and replacement of the working parts are details of vital importance to every engineer. In short, it is an ideal Trap.

Special Catalogue on request.

NASON MFG. CO., 71 Fulton Street, New York

Simple as A B C



The simplicity of any apparatus is in direct proportion to the fewness of its movable parts.

It requires only the removing of three nuts to get at the tube-spring, which constitutes the entire interior of the

Marck Steam Trap

This trap operates on the well known principle of the Boudon steam gauge. The tube-spring is filled with a special fluid which forms a gas above 212 degrees Fahr., the temperature of live steam.

When there is no steam on the line, the **Marck Steam Trap** is open, allowing the system to drain of all water. Within 30 seconds after the first appearance of live steam at the inlet, the tube-spring expands, closing the valve, which stays closed until as little as half an ounce of water collects at the inlet.

You can prove the tightness of the valve under pressure by holding a lighted match at the outlet.

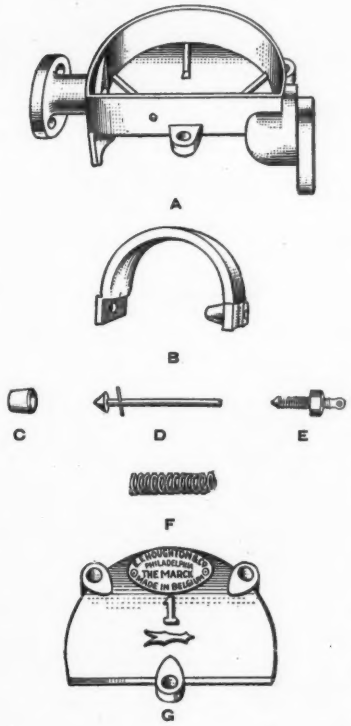
As the diameter of the valve is as large as the pipe connections, it is self-evident that a 1-inch **Marck Steam Trap** can immediately take care of all the water that will reach it through a 1-inch pipe. This is only one superior point which makes the **Marck** preferable to float and bucket traps, whose discharge valve is usually *smaller* than the pipe connections.

The **Marck Steam Trap** operates perfectly under any pressure from 5 to 150 pounds without re-adjustment.

As the natural position of the trap when not in use is *open*, it is not necessary for the engineer to go around opening drainage valves when shutting down, or opening air-valves before starting up in order to prevent freezing or becoming air-bound as is the case with "water seal" traps.

The **Marck Steam Trap** contains no water reservoir, therefore it will not *increase* condensation or freeze during shut-downs in cold weather.

The **Marck Steam Trap** does not require the power of steam to *lift* the condensation from the bottom *to the top* of the trap in order to discharge. It drains by *gravity*, instantly.



A—Case.

B—Tube Spring.

C—Valve Seat.

D—Valve and Joint Pin.

E—Regulating Screw.

F—Brass Spring (Immovable).

G—Cover.

In short, the **Marck Steam Trap** is a really trustworthy trap, taking care of sudden flushes of water, or a half-ounce, immediately, positively, and without any attention whatever on the part of the engineer. When you install **Marck Steam Traps** you eliminate many of the worries of the engineer's job, and add that much to your spare time.

The **Marck Trap** has superseded all other types in European countries; it is specified exclusively by government engineers. There are already nearly 1,000,000 **Marck Steam Traps** in daily service in this country, and it is only a question of time when they will be as widely used in America as they are in Europe.

The price of the **Marck** is surprisingly low, considering its capacity.

Now, as to guarantee, the **Marck Steam Trap** is sold under the strongest guarantee ever given with a steam trap. Send us your requirements, we will see that the trap reaches you and is installed correctly. If it is not satisfactory at the end of 30 days (or even 60 days if you wish) return it and it won't cost you a cent. If satisfactory, we guarantee it against all defects in material and workmanship for a period of *two* years.

Don't wait for cold weather freeze-ups to convince you that your water-bucket and float traps are out of date.

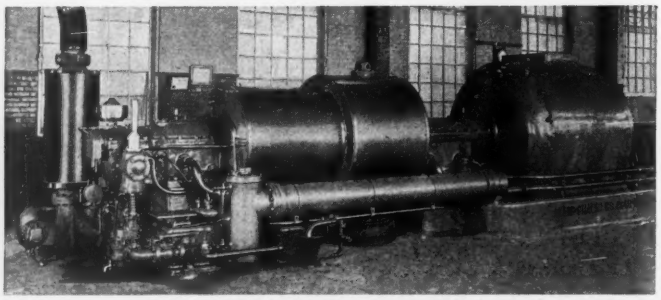
Write for the **Marck Steam Trap Book** and name of nearest **Marck** agent, today.

Established 1870

E. F. Houghton & Company

2745 N. Third Street, Philadelphia, Pa.

THIS TURBINE GETS DRY STEAM



The greatest single factor contributing to the safe and efficient operation of this turbine is the vertical **Sweet's Separator** which you can see installed.

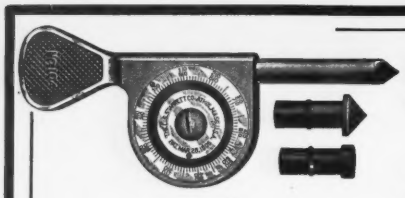
Sweet's Separators Deliver Steam 99.8% Dry

Hundreds are in use and giving perfect results. In fact 50 per cent of all Sweet's Separators sold have gone out on "repeat orders." **When they buy and come for more they MUST be good.**

Our catalogue shows illustrations and gives a complete description of the construction and operation of Sweet's Separators. It should be read by every user and buyer of turbines, engines and pumps.

Write for a copy today.

THE DIRECT SEPARATOR COMPANY, 820 Geddes St., Syracuse N. Y.



No. 104

PRICE, POSTPAID, $1.00

Starrett Speed Indicator

This indicator may be run at highest speed required without heating. The working parts are encased. The dial has two rows of figures, reading either right or left as shaft may run. Has steel pointed spindle with rubber tips for both pointed and centered shafts. The (0) mark may be instantly set at the starting point. *Send for free Catalog 19-N., of Fine Tools*

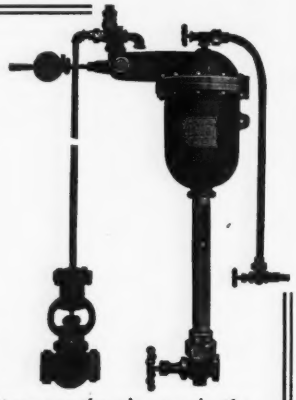
THE L. S. STARRETT COMPANY,
ATHOL, MASS.

Starrett Tools

For Security Against Boiler Repairs, Accidents and Shut-Downs

TRY A

Vigilant Regulator



Vigilant Feed Water Regulators are the pioneers in the automatic control of boiler feed supply.

Have been on the market longest, and

More of them in use than all other makes.

They are the best example of simplicity and thorough efficiency.

Contain no floats—no diaphragms, no complicated set of levers no small valves, hidden parts nor obscure steam passages.

Operation does not depend on expansion or contraction, but is positive and dependable after years of service.

If your boiler does not come up to rated capacity or is incapable of overload when required, a Vigilant Regulator will overcome those conditions and give you immunity from danger, frequent boiler repairs, and an inflated fuel account.

These results are worth getting.

Send for a Vigilant. You can test it on one of your own boilers for 60 days before obligating yourself for a cent.

Send for full details today.

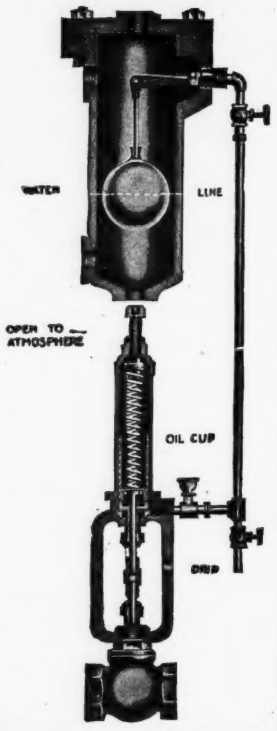
THE CHAPLIN-FULTON MFG. CO., Pittsburgh, Pa.

Also Manufacturers of the Fulton Pump Govenor

Represented by D. W. Patterson, Harrison Bldg., Philadelphia; J. E. Gimperling & Son, Dayton; J.S.Ward, Chicago; J.A.Grant, Tremont Bldg., Boston

The Murray Automatic Boiler Feed Regulator

Keeps the Water Level Right



And a true water level means less repairs, less fuel wasted, increased efficiency all around, decreased labor expense and protection from boiler explosions. In one plant where they are installed, the saving in labor alone amounts to $4.00 a day—one water tender taking care of 15 boilers.

Murray's Regulators are constructed to assure durability, and are free from complications that cause derangement and repairs.

Let us send you Catalog of Murray's Steam Specialties. Your request or any inquiries you make will be given prompt attention.

Murray Automatic Boiler Feed Company

Detroit, Michigan

The "Wyoming" Steam Trap

The Trap that embodies every feature possessing merit found in any steam trap, regardless of price

BEFORE placing an order for a trap, inquire whether or not it possesses the following features, which it should possess in order to receive your consideration as a durable and efficient steam trap.

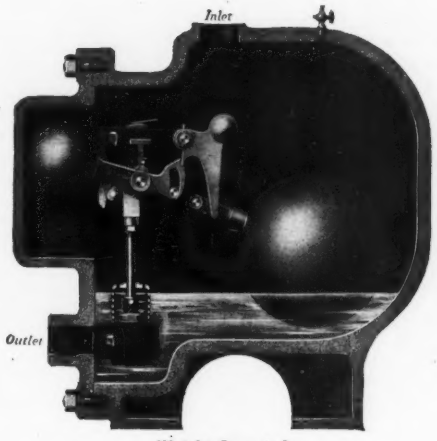
(1) Instantaneous opening and closing of the discharge valve. In other words, a non-wire-drawing valve.

(2) Intermittent discharge.

(3) Water sealed discharge valve.

(4) Ample capacity.

What is the cause of nine-tenths of all trap troubles? Is it not leaky valves? What is the cause of leaky valves? Is it not wire-drawing in most cases? In some makes of traps the valve opens gradually and closes gradually; in others it opens suddenly but closes gradually, which causes a wire-drawing action through the valve, consequently the life of the valve and seat is of short duration.



Weight Operated

On the other hand the "Wyoming" opens and closes instantaneously, avoiding all possible chance of wire-drawing. Its efficiency, durability and capacity is guaranteed.

Sent on 30 days trial. Moderate in price.

Write for Circular.

W. H. NICHOLSON & COMPANY, Wilkes-Barre, Pa.

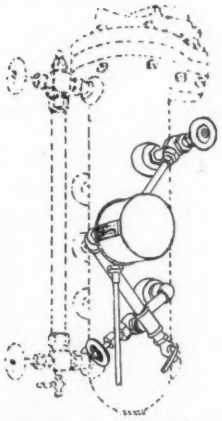
YOUR BOILER

The Basis of Plant Efficiency

You, Mr. Engineer, have often stopped to consider the importance of steady water level in the boiler.

Steady water level means dry expansive steam with consequent fuel economy and engine efficiency.

It also means elimination of danger and repairs from high or low water in the boiler.



We guarantee "S-C" Water Level Regulators to maintain the water level within one inch of any desired point.

They do their work efficiently and reliably. There are no floats, needle valves, or other intricate parts to get out of order.

Write for full particulars today.

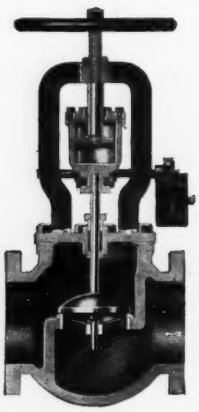
THE "S-C" REGULATOR COMPANY

311 Perry Street, Fostoria, Ohio

Your Boilers Are the Heart of Your Plant— Protect Them

Don't jeopardize the lives of your employees—the safety of your property. One of your boilers in the battery may give way at any minute. When it does there will be a tremendous rush of steam from the other boilers and there is no way to stop it with safety. The damage that may result cannot be estimated.

But if the Davis Class C Valve is protecting your boilers—you are safe. This valve acts instantly when a reverse flow of steam occurs and automatically cuts out the disabled boiler. The damage is confined to one unit and your plant is not put entirely out of business—You can operate while repairs are being made.



IS IT SURE TO WORK?

This is an important question, and here's the answer:—The outside oil Dash Pot positively eliminates all liability of sticking due to expansion of metals or scale formation. The Counterweight Lever moves in unison with the disc—you can see this valve work, and you can test it by hand any time.

The Davis Class C Automatic Stop and Check or Non-Return Valve

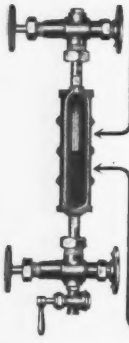
Is strongly recommended by Insurance Companies as a means of preventing accidents. They know from experience what can happen to the unprotected plant.

The Sherwin-Williams Co., the National Lead Co., the Illinois Steel Co., the International Harvester Co., the Packard Motor Car Co., the American Locomotive Co., and many other progressive concerns use the Davis Class C Valve to prevent shut-downs and accidents.

Let us show you how easily and cheaply this safety device may be applied to your present equipment or to your proposed new plant.

G. M. DAVIS REGULATOR COMPANY, 427 Milwaukee Avenue, CHICAGO

NEW YORK 123 Liberty Street · BOSTON 70 High Street · PHILADELPHIA 2528 N. American Street · PITTSBURGH Park Bldg. · MINNEAPOLIS Bank of Commerce Bldg. · ST. LOUIS 735 S. 4th Street · SAN FRANCISCO Metropolis Bank Bldg.



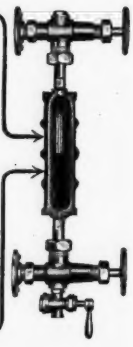
STEAM REFLEX'S WHITE

A safe water gauge under all existing conditions.
We guarantee the glass not to fly.
A gauge that requires no attention.
If you knew its tremendous advantages, you would never be without it.

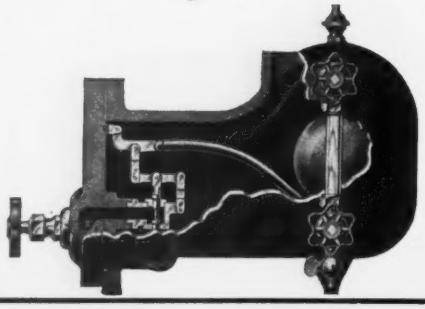
WRITE FOR BOOKLET "C"

JERGUSON MANUFACTURING COMPANY
222 COLUMBUS AVENUE BOSTON, MASSACHUSETTS

WATER REFLEX'S BLACK



THE *Eclipse* STEAM TRAP



There Are Many Good Reasons

for installing the "Eclipse" Steam Trap, but the chief reason is that it effectively and rapidly drains both high and low pressure systems and takes care of all condensation up to the full capacity of the pipe; the flow being continuous at all times. As it is interchangeable it handles all pressures from 150 lbs. down.

The valve is made of government steam brass and is perfectly balanced. All parts of trap can be removed by simply taking off cap.

The trap can be blown free of sediment by operating hand-wheel. It is fully guaranteed covering operation, material and workmanship.

Our complete line of steam specialties is fully described in our catalog. By all means send for it.

HUGHSON STEAM SPECIALTY CO., 5021-5023 STATE STREET, CHICAGO

Successors in the Manufacture of the Eclipse Steam Specialties of the John Davis Co., Chicago

Representatives: W. G. Ruggles Co., 45 High St., Boston; Jas. H. Pearson, 122 Center St., New York; Geo. T. Ladd, 1620 Farmers' Bank Bldg., 608 Chestnut St., Pittsburgh; Western Valve Co., St. Louis, Mo; Theo. F. Dredge, Monadnock Bldg., San Francisco; J. A. Roe Co., Detroit; Hunter B. Frischkomi, Richmond, Va.; B. Natkin, Kansas City, Mo.

There's a Mason Reducing Valve To Meet Your Every Requirement

All Bronze Reducing Valve. Large Metal Diaphragm, Close Regulation on Low Pressures.

For Reducing Steam Pressure From Any Pressure Up to 300 Pounds To Any Low Pressure between 0 and 15 Pounds.

a Valve *designed* for (not "adapted to") each variation of service that a Reducing Valve can or should perform. And running through the entire line—as much a part of it as its time-tried designs—is a care in the selection of materials, and in manufacturing that *guarantees* the highest, most uniform efficiency. Added to this is an *Engineering Service*—an *Advisory* Service—for those who desire assistance in the selection of the type or types of Mason Reducing Valves best suited to their own peculiar conditions. And this is not merely a selling service, because it follows Mason Valves into your plant, and is not content until it has accomplished *exactly* the results that *you* require.

All Bronze Differential Reducing Valve With Large Diaphragm

Buy By This Mark

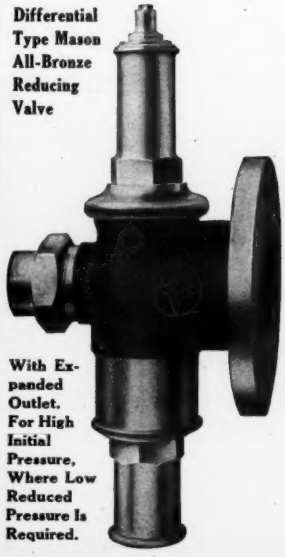
The Mark of Known Quality

The few illustrations and brief descriptions given here will convey to you some idea of the *completeness* of the Mason line—its ability to meet every need arising in your plant for the

Buy By This Mark

The Mark of Known Quality

Automatic, Accurate, Positive and Continuous Control and Regulation of Steam, Air and Water Pressures



Differential Type Mason All-Bronze Reducing Valve

With Expanded Outlet. For High Initial Pressure, Where Low Reduced Pressure Is Required.

Write us at once for Illustrated Catalog describing in detail our principal devices. Tell us of any "trouble spots" and we shall be glad to give you, without charge, the benefit of our almost-a-third-of-a-century experience in meeting such conditions.

Mason Valves are carried in stock by dealers and supply houses in all the larger towns and cities. If your dealer hasn't them, write direct to us and we will see that you are supplied promptly.

Mason Regulator Co.

Dorchester Center, Boston, Mass.

Key to **Steam Engineering**

P. E. 12-1-11

Find enclosed 25 cents, for which send me postpaid copy of your handbook—"Key to Steam Engineering."

MASON

Name .....

Address .....

Putting Aside The Many Other Advantages Of Reliance Columns There Is One Good Reason Why You Should Have A Reliance On Every Boiler In Your Power Plant.

And that one good reason is—**SAFETY.**

As important as are the subjects of **efficiency** and **economy** the **safety** of yourself, your employes and the **protection** of your property should receive your keenest consideration.

You need a **reliable** water column on every boiler in your plant.

Then why not get the **Reliance?**

It will discourage negligence in water tending and sound an **alarm** when the water line approaches the danger points.

It is an absolute check on the firemen's work, furnishing positive protection from boiler explosions due to low water and wrecked engines due to high water.

Naturally, better regulation means increased efficiency all around—a saving in coal and a reduction in repair expense. These are just what you want and **can have** if you put **Reliance Columns** to work in your plant.

70,000 or more are at present in use—a very good indication that they do their work right.

Ask us for our illustrated catalog. Contains complete interesting information about **Reliance Columns.**

The Reliance Steam Trap

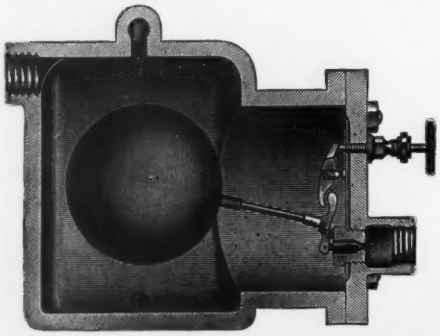
is a durable, well made trap of **great capacity** and **highest possible efficiency.**

It meets the most severe requirements in a way unapproached by any other trap. **Fully guaranteed.** May we favor you with our catalog?

THE RELIANCE GAUGE COLUMN COMPANY

72 East Prospect Street, Cleveland, Ohio

EASTERN OFFICE: 18th and Market Streets, Philadelphia
WESTERN OFFICE: 43-45 Franklin Street, Chicago



For Reducing Pressure

There's No Better Valve Than The

KITTS

REDUCING VALVE

It is marvelous in its simplicity—sensitive and quick acting.

The weighted lever raises the valve disc and allows the steam entering at the inlet to pass at a reduced pressure through the valve and down into the diaphragm chamber. This chamber fills with condensation and is kept cool at all times hence the steam cannot come in contact with the diaphragm. By adjusting the ball weight the reduced pressure is easily changed.

Compound levers prolong the life of the diaphragm by reducing its movement to a minimum—also prevent the valve discs from jumping and hammering.

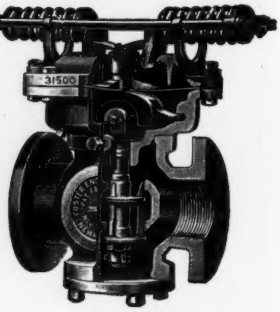
Have you seen our catalog on Reducing Valves, Steam Traps, Damper Regulators, Feed Water Regulators, etc? If you haven't wouldn't it be a wise plan to send for it today?

KITTS MANUFACTURING CO.

OSWEGO, N. Y.

Pittsburgh, 525 Third Avenue **New York, 143 Liberty Street**

Foster Valves



Class "W"

"Reliability Their Main Feature"

THE better plan and the wisest, is to eliminate experiment and costly experience by starting from the beginning with the right pressure-reducing valve.

The Foster Class "W" High Pressure Reducing Valve

is extremely sensitive, the mechanism is not frail in construction, nor easily deranged.

Some of the largest power plants in the United States can vouch for its wearing qualities and dependability.

SEND FOR NEW FOSTER CATALOG

FOSTER ENGINEERING CO., Newark, N. J.

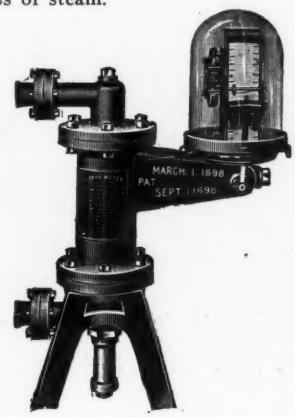
Room 520, 180 N. Dearborn Street, Chicago, Ill.
161 Summer Street, Boston, Mass.
914 Farmers' Bank Building, Pittsburgh, Pa.
601 Harrison Building, Philadelphia, Pa.

Makers of High Pressure Regulators, Low Pressure Regulators, Back Pressure Valves, Free Exhaust Valves, Non-Return Stop Valves, Emergency Valves, Class U Pressure Regulators, Excess Boiler Feed Pump Governors, Etc.

Keep an Accurate Record of the Steam You Use

Then you can compare one day's record with that of another and economize accordingly. You can also detect and prevent the loss of steam.

The **St. John** Indicating and Recording Meter



measures every cubic foot of steam, air or gas passing through it and makes a continuous record each hour of the day. The record can be read very easily and is made on charts so that it can be filed for future reference. The St. John meter is very simple in construction. Just how simple it is, is fully explained in our catalogue. May we send it?

G. C. ST. JOHN, 90 West St., New York, N. Y.

Be up-to-date and install our

Atmospheric System of Steam Heating

We maintain a large engineering force and are able to prepare promptly plans and specifications covering the requirements of prospective customers.

As a starter send at once for BULLETIN No. 119.

American District Steam Company
Lockport, N. Y.
N. Tonawanda, N. Y. - - - Chicago

Ⓑ

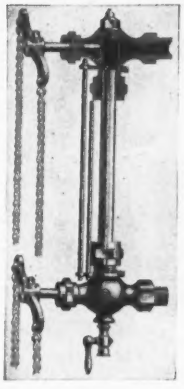
Free Movement of Parts in OHIO Pressure Regulating Valves

Type F Valve—Patented

is one reason why they are giving **absolutely dependable** service. OHIO Valves will not stick but give **continuous close** regulation under the severest service conditions.

Order an OHIO Valve for Trial, to be returned at our expense if it does not give satisfaction.

OHIO Water Gauge



comes to you fully packed with high grade packing, ready to use and complete with Guard Rods and Operating Chains.

It opens or closes with a one-quarter turn of the levers and can be shut off from a safe distance, thus protecting the operator against scalding.

It can be fitted with OHIO Ball Bearing Gauge Glands which relieve the glass from twisting strains.

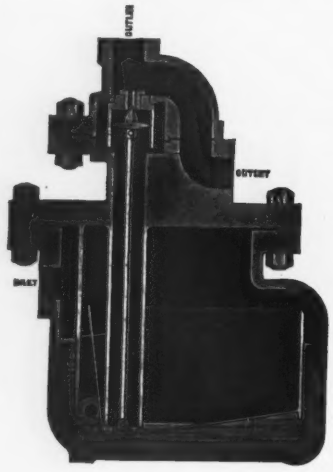
Your Dealer can supply all OHIO Steam Specialties promptly.
Write for New Catalog K-P.

THE OHIO BRASS CO.
MANSFIELD, OHIO, U. S. A.

All We Ask for Strong Steam Traps is a 90 Days' Trial

REGISTERED TRADE 4/S MARK

Make a note, and the next time you need a trap send to us for a Strong, use it 90 days. If you don't like it just return at our expense, and in order that you may be posted all about Strong Traps and other Strong specialties, let us send you our Catalog (E 14) right now, and don't forget that



"On Their Merits Alone We Ask Your Patronage"

The Strong, Carlisle & Hammond Co.

346 Frankfort Ave.

Cleveland, - - Ohio

180 High Street	261 Centre Street	908 Chestnut Street	432 Wood Street	542 So. Dearborn Street
Boston	New York	Philadelphia	Pittsburgh	Chicago

KEEPING GAUGE GLASS TROUBLES OUT

of the boiler room is an easy proposition when you install the *Sonderglas* Brand of German Glasses.

Unlike the Scotch gauge glass the *Sonderglas* never becomes cloudy and obscure; it shows the water line clearly at all times. And it is pressure proof, being made of two tubes fused into one, each tube having a different degree of expansibility. No breaking glasses, no escaping steam, no flying particles of broken glass. *Sonderglas* is not affected by expansion or contraction and so will stand many times the pressure of the old-fashioned kind.

If your dealer cannot furnish you with Sonderglas — we will.

A. W. Chesterton Co.

64 India St. Boston, Mass.

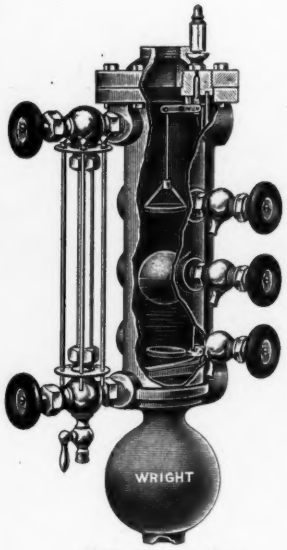
DURABLA blown on every glass

DURABLA

High Pressure Gauge Glass.

The need in modern plants of a perfect gauge glass created DURABLA Quality of Glass, a High Pressure Glass that will remain clear while in service, resist chemicals, sudden changes in temperature, and offer needed security. Buy it. We guarantee every tube.

R. G. VON KOKERITZ & CO., 114 Liberty Street, New York



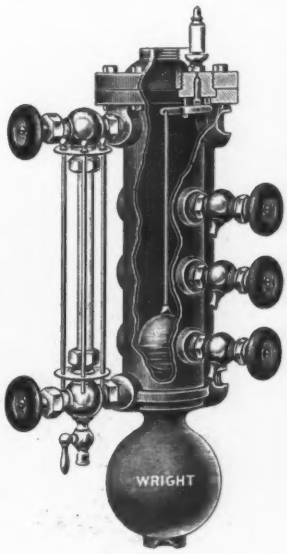
High and Low Alarm

"Wright"

Improved Safety Alarm

Water Columns

are the Most Positive, the Most Dependable, the Most Durable, and, in the end, the Most Economical Columns on the market. They are approved by all Federal and State Inspectors, and strongly endorsed by thousands of protected users. We ship them on trial; try one for a month or so entirely at our risk.

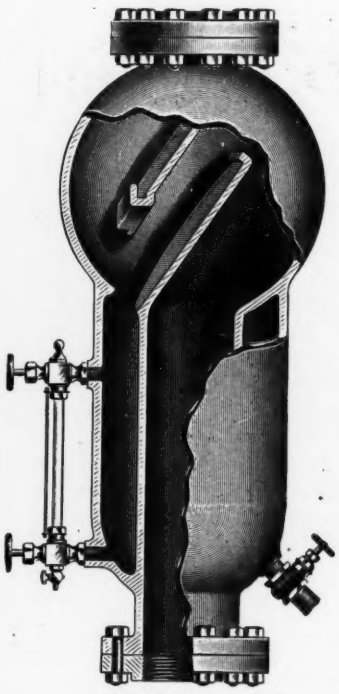


Low Alarm Only

Send for Catalog C-80

Wright Manufacturing Company

Detroit, Michigan **72 Woodbridge Street**


Write for Illustrated Catalog D-30 showing many types

Austin

Figure "M"

Vertical Iron Receiver

Steam Separator

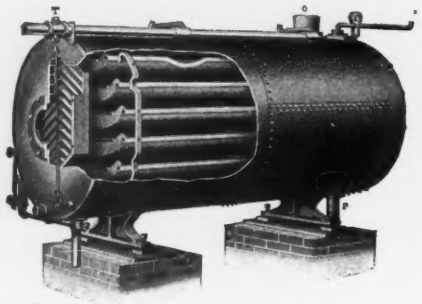
Takes all the water out of the live steam current—insures Dry Steam in the Engine Cylinders, and that means High Engine Efficiency, Minimum Fuel and Lubricant Expense, and Sure Protection Against Cylinder Explosions.

Try one out for 30 days at our risk. If it doesn't do all we claim for it, ship it back "collect."

Austin Separator Co.

Detroit, Michigan **23 Woodbridge Street**

HOPPES

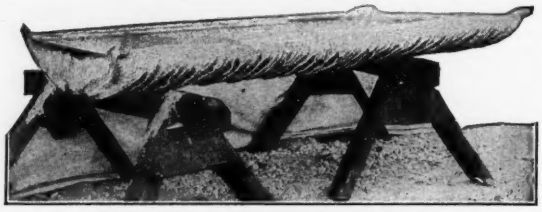


"Standard" Steel Construction Heater and Purifier

Exhaust Steam Feed-Water Heaters and Purifiers

Owe their superior heating and purifying qualities to their extensive heating and lime-catching surface. The entire shell of heater (except the water reservoir in the bottom) is filled with trough-shaped pans, and the water in passing through the heater, as it overflows the sides of the pans, follows the curved bottoms *in a thin sheet or film.* This keeps it in constant direct contact with the steam in such a manner that it absorbs a maximum amount of heat and attains a temperature of 208 to 212 degrees F., varying a few degrees according to local conditions.

The high temperature thus obtained drives off the carbonic acid gas and precipitates the carbonates which are deposited and retained on the pans (as shown in cut). These pans rest on slides or ways, are easily removable for cleaning, and their peculiar advantages over other forms of heating surfaces are briefly as follows:



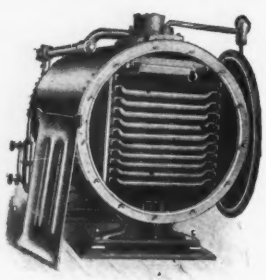
Pan from Steel Construction Heater showing Lime Deposit

They give *double* the amount of heating surface afforded by a flat plate as the water held in the troughs of the pans as well as that flowing along the bottoms is always in contact with the steam.

They *do not clog up* and become ineffective as is the case with spraying devices and perforated plates, and an ordinary deposit of lime does not effect the usual flow of the water, cleaning being necessary only at reasonable, regular intervals.

The troughs of the pans also serve as settling chambers for solids in suspension and *make filtering unnecessary.*

In addition to the above, the amount of heating surface in a Hoppes Heater is always *definitely known and sufficiently extensive* to give the best results obtainable from a heater of its rated horse power, so that when you purchase a Hoppes Heater for a given horse power you are *sure* to get one that will do the work expected.



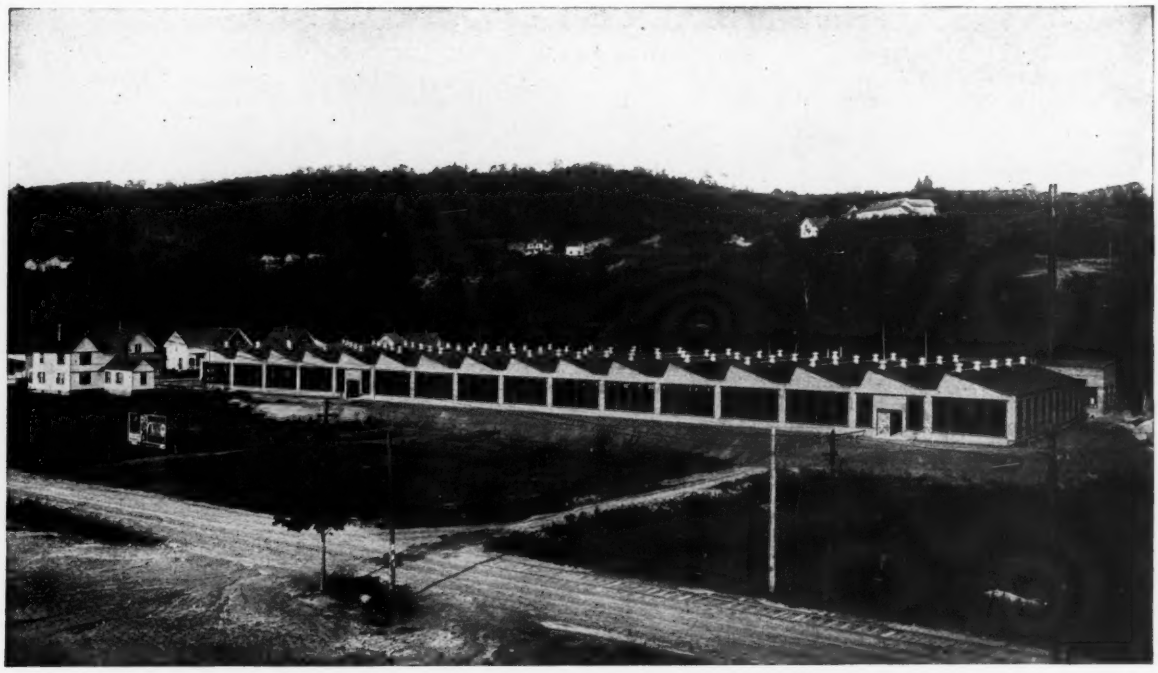
Class "R" Heater showing Multi-Trough-Shaped Cast Iron Pan

Hoppes Heaters are built in both Steel and Cast Iron types and with or without extra water storage capacity to suit requirements. Each heater is equipped with a large and efficient oil eliminator and automatic feed-water control, and is *guaranteed in every respect.* Our catalog No. 40 fully explaining Hoppes Machines and Methods is free on request, and we are always glad to give you the benefit of our long experience in the design and manufacture of successful heating and purifying apparatus as it may relate to your particular case. Write us. It may save you money, time and worry.

We also Manufacture

Steam Separators, Oil Eliminators and Cast Iron Exhaust Heads, Live Steam Feed-Water Purifiers

The Hoppes Mfg. Co., 70 Larch St., Springfield, O.



Burt Ventilators For Machine Shops

80 Burt Ventilators on the saw-toothed roof of The Jones & Lamson Machine Co.'s shop at Springfield, Vt.

In machine shops where dust is constantly rising and where men are working close to each other, good ventilation is as essential as sufficient light.

Drowsiness, frequently the result of breathing impure air, has a marked effect on the activity of the workmen, and not only depreciates the quantity but also the quality of their output.

Burt Ventilators assure the best atmospheric conditions in these shops because they draw out the impure, dust laden air, leaving only that which is fresh and invigorating.

They thus increase the efficiency of each employee —improve his work and also his health.

Employers, now, more than ever before, are giving careful attention to the proper ventilation of their shops, factories, power houses or any other class of building. After investigating the problem they generally select **Burt Ventilators** as they find them to be the most effective, requiring no attention and no upkeep cost. This statement is verified by their many repeat orders.

A good example of machine shop ventilation is shown in the illustration above.

Since supplying this shop with Burt Ventilators we equipped one hundred and two other machine shops, among them being:

The Nicholson File Co., Paterson, N. J., 11-16 in. Ventilators, 4th order.

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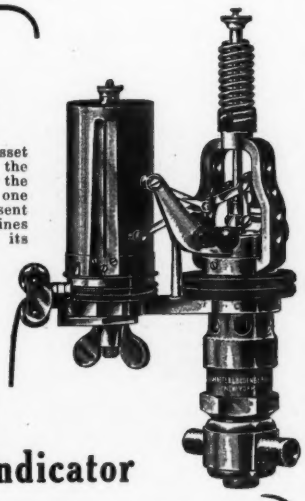

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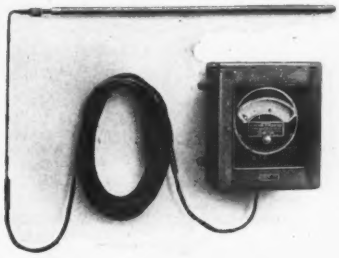

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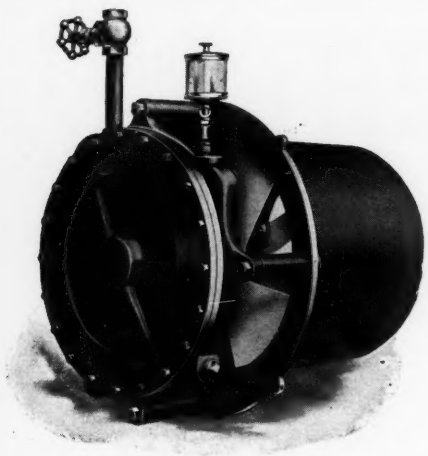

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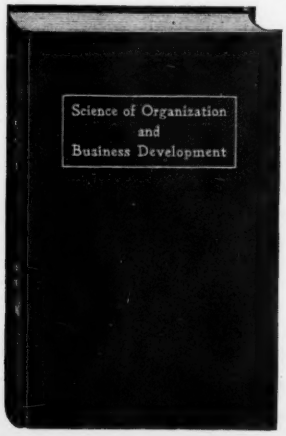

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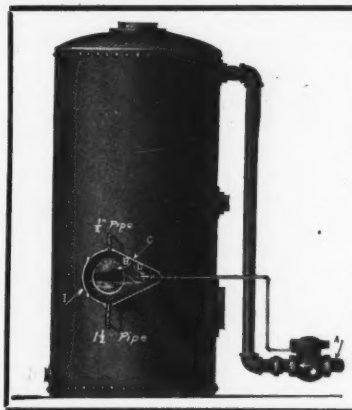

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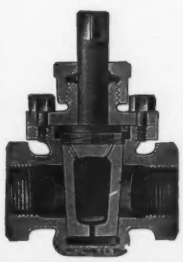

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Johns-Manville Co., H. W., New York.
Sprague Electric Works, New York.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

ELEVATOR BUCKETS.

Jeffrey Mfg. Co., The, Columbus, Ohio.

ENGINES, GAS AND GASOLINE.

American Well Works, The, Aurora, Ill.
Bogart Gas Power Engineering Co., Buffalo, N. Y.
Bruce-Macbeth Engine Co., The, Cleveland, Ohio.
Buckeye Engine Co., Salem, O.
Elyria Gas Power Co., The, Elyria, Ohio.
Gilson Mfg. Co., Port Washington, Wis.
Int. Harvester Co. of America, Chicago, Ill.
Oil City Boiler Works, Oil City, Pa.
Struthers-Wells Company, Warren, Pa.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

ENGINES, STEAM.

American Engine Co., Bound Brook, N. J.
American Well Works, The, Aurora, Ill.
Atlas Engine Works, Indianapolis, Ind.
Bates Machine Co., Joliet, Ill.
Ball Engine Co., Erie, Pa.
Brownell Co., The, Dayton, O.
Buckeye Engine Co., Salem, O.
Cooper Co., C. & G., Mt. Vernon, Ohio.
De Laval Steam Turbine Co., Trenton, N. J.
Ide & Sons, A. L., Springfield, Ill. "Ideal."
Harrisburg Foundry & Machine Works, Harrisburg, Pa. "Fleming-Harrisburg."
Hooven, Owens, Rentschler Co., Hamilton, O. "Hamilton-Corliss."
Ridgway Dynamo & Engine Co., Ridgway, Pa.
Russell Engine Co., Massillon, O.
Skinner Engine Co., Erie, Pa.
St. Louis Iron and Mach. Wks., St. Louis, Mo.
Sturtevant Co., B. F., Hyde Park, Mass.
Vilter Mfg. Co., The, Milwaukee.
Westinghouse Machine Co., Pittsburg, Pa.
York Mfg. Co., New York.

ENGINE STOPS.

Consolidated Engine Stop Co., New York, N. Y.
Strong, Carlisle & Hammond Co., Cleveland, O.

EXHAUSTERS, GAS.

Ohio Blower Co., Cleveland, O.
Sturtevant Co., B. F., Hyde Park, Mass.

EXHAUST HEADS.

Burt Mfg. Co., Akron, O. "Standard."
Direct Separator Co., Syracuse, N. Y.
Hoppes Mfg. Co., Springfield, O.
Ohio Blower Co., Cleveland, O. "Swartwout."
Pittsburgh Gage & Supply Co., Pittsburgh, Pa.
Robertson & Sons, Jas. L., New York.
Sturtevant Co., B. F., Hyde Park, Mass.
Watson & MacDaniel Co., Philadelphia, Pa.
Wright Mfg. Co., Detroit, Mich. "Cyclone."

FANS, ELECTRIC.

Sprague Electric Works, New York.
Westinghouse Electric & Mfg. Co., Pittsburgh, Pa.

FANS, EXHAUST AND VENTILATING.

Anderson Co., The, V. D., Cleveland, Ohio.
Green Fuel Economizer Co., The, Matteawan, N. Y.
Ohio Blower Co., Cleveland, O.
Sprague Electric Works, New York.
Sturtevant Co., B. F., Hyde Park, Mass.

FEED WATER CONTROLLERS.

Chaplin-Fulton Mfg. Co., Pittsburg, Pa. "Vigilant."
Jerguson Manufacturing Co., Boston, Mass.
Kitts Mfg. Co., Oswego, N. Y.
Murray Automatic Boiler Feed Co., Detroit, Mich.
"S-C" Regulator Co., Fostoria, O.
Squires Co., The, C. E., Cleveland.
Strong, Carlisle & Hammond Co., Cleveland, O.
Williams Gauge Co., Pittsburgh, Pa.

FEED WATER FILTERS.

Lagonda Mfg. Co., Springfield O.

FEED WATER HEATERS AND PURIFIERS.

Alberger Condenser Co., New York.
Bates Machine Co., Joliet, Ill. "Cookson."
Blake & Knowles Steam Pump Works, New York, N. Y.
Brownell Co., The, Dayton, Ohio.
Elliott Co., Pittsburgh, Pa. "Pittsburgh."
Harrison Safety Boiler Works, Philadelphia, Pa.
Hoppes Mfg Co., Springfield, O.
National Pipe Bending Co., New Haven, Conn.
Open Coil Heater & Purifier Co., Indianapolis, Ind "Stickle."
Robertson & Sons, Jas. L., New York.
Russell Engine Co., Massilon, Ohio.
Stewart Heater Co., Buffalo, N. Y. "Otis."

FILTERS, OIL.

Burt Mfg. Co., Akron, O. "Cross."
Elliott Co., Pittsburgh, Pa.
Flower Co., Walter L., St. Louis, Mo. "Acme."
Franklin Oil Filter Co., St. Louis, Mo.
Pittsburgh Gage & Supply Co., Pittsburgh, Pa. "White Star."
Richardson-Phenix Co., The, Milwaukee, Wis.
Robertson & Sons, Jas. L., New York.
Wright Mfg. Co., Detroit, Mich.

FIRE BRICK.

Betson Plastic Fire Brick Co., Rome, N. Y.
Harbison-Walker Refractories Co., Pittsburgh, Pa.
McLeod & Henry Co., Troy, N. Y.

FITTINGS, FLANGE AND PIPE.

American District Steam Co., Lockport, N. Y.
Direct Separator Co., Syracuse.
Goulds Mfg. Co., Seneca Falls, N. Y.
Kroeschell Bros. Co., Chcago, Ill.
Lunkenheimer Co., The, Cincinnati, Ohio.
National Tube Co., Pittsburgh, Pa.
Pittsburgh Valve Fdy. & Construction Co., Pittsburgh, Pa.
Richardson-Phenix Co., "Union Cinch."
Williams Valve Co., D. T., Cincinnati, O.

FLANGES, CAST AND MALLEABLE.

Direct Separator Co., Syracuse.
National Tube Co., Pittsburgh, Pa.

FLOATS.

Anderson Co., The V. D., Cleveland, Ohio.
Pittsburgh Gage & Supply Co., Pittsburgh, Pa.
Reliance Gauge Column Co., Cleveland, O.

FLUE CLEANERS.

Central Machine and Fdry. Co., Marion, Ind. "Hoosier."
Chesterton & Co., A. W., Boston, Mass.
"Diamond" Power Specialty Co., Detroit, Mich. "Diamond."
Johns-Manville Co., H. W., New York.
Lagonda Mfg. Co., Springfield, O.
Marion Machine Foundry & Supply Co., Marion, Ind.
Monarch Steam Blower Co., Troy, N. Y.
Sherwood Mfg. Co., Buffalo, N. Y.
Stewart Heater Co., Buffalo, N. Y.

FRICTION CLUTCHES.

Williams Foundry and Mach. Co., The, Akron, Ohio. "Akron."

FURNACES.

Harbison-Walker Refractories Co., Pittsburgh, Pa.

FUSE SHELLS, REFILLABLE CARTRIDGE.

Daum Co., A. F., Pittsburgh, Pa.

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Carpenter & Co., Geo. B., Chicago.
Cincinnati Gasket and Packing Co., Cincinnati, Ohio. "Trinity," "Tripie."
France Packing Co., The, Philadelphia, Pa.
Goetze Gasket & Packing Co., Brunswick, N. J.
Gutta Percha & Rubber Mfg. Co., The, New York.
Jenkins Bros., New York. "96."
Johns-Manville Co., H. W., New York.
McCord Mfg. Co., Detroit, Mich.
N. Y. Belting & Packing Co., Ltd., New York.
Peerless Rubber Mfg. Co., New York.
Quaker City Rubber Co., Philadelphia. "P. P. P." "Ebonite."
Smooth-on Mfg. Co., Jersey City.
Von Kokeritz & Co., R. G., New York. "Durabla."

GASOLINES.

Standard Oil Co., Inc.

GAS PRODUCERS.

Bogart Gas Power Engineering Co., Buffalo, N. Y.
Power & Mining Machinery Co., Cudahy, Wis.
Westinghouse Machine Co., Pittsburg, Pa.

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American Well Works, The, Aurora, Ill.
Ashton Valve Co., Boston, Mass.
Ashcroft Mfg. Co., The, New York.
Bristol Co., The, Waterbury, Conn.
Lunkenheimer Co., Cincinnati, O.
Pittsburgh Gage & Supply Co., Pittsburgh, Pa.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N. Y., "S. & B."

GAUGES, RECORDING.

Ashcroft Mfg. Co., The, New York.
Ashton Valve Co., Boston, Mass.
Bristol Co., The, Waterbury, Conn.
Lunkenheimer Co., Cincinnati, O.
Ohio Blower Co., The, Cleveland.
Pittsburgh Gage & Supply Co., Pittsburgh, Pa.
Williams Valve Co., D. T., Cincinnati, O.

GAUGES, WATER.

American Injector Co., Detroit.
Ashcroft Mfg. Co., The, New York.
Cincinnati Gasket and Packing Co., Cincinnati, O.
Detroit Lubricator Co., Detroit.
Huyette Co., The Paul B., Philadelphia, Pa. "P. B. H."
Jenkins Bros., New York. "Grabber."
Jerguson Manufacturing Co., Boston, Mass. "Reflex."
Lunkenheimer Co., The, Cincinnati, O.
Ohio Blower Co., The, Cleveland.
Ohio Brass Co., The, Mansfield, O.
Penberthy Injector Co., Detroit.
Pittsburgh Gage & Supply Co., Pittsburgh, Pa.
Powell Co., Wm., Cincinnati, O.
Reliance Gauge Column Co., Cleveland, Ohio.
Williams Valve Co., D. T., Cincinnati, Ohio.

GAUGE BOARDS.

Ashcroft Mfg. Co., The, New York.
Bristol Co., The, Waterbury, Conn.
Pittsburgh Gage & Supply Co., Pittsburgh, Pa.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N. Y. "S. & B."

GAUGE COCKS.

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Ashcroft Mfg. Co., The, New York.
Cadman Mfg. Co., A. W., Pittsburgh, Pa.
Detroit Lubricator Co., Detroit.
Huyette Co., The Paul B., Philadelphia, Pa. "P. B. H."
Jerguson Manufacturing Co., Boston, Mass. "Wiltbonco."
Jenkins Bros., New York.
Lunkenheimer Co., The, Cincinnati, Ohio.
Nason Mfg. Co., New York. "Aetna."
Nicholson & Co., W. H., Wilkes-Barre, Pa.
Ohio Blower Co., The, Cleveland.
Ohio Brass Co., The, Mansfield, O.
Penberthy Injector Co., Detroit.
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Powell Co., The Wm., Cincinnati.
Reliance Gauge Column Co., Cleveland, Ohio.
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Cincinnati Gasket Packing Co., Cincinnati. "Adamant."
Jerguson Manufacturing Co., Boston, Mass.
Lunkenheimer Co., The, Cincinnati, Ohio.
Peerless Rubber Mfg. Co., New York.
Quaker City Rubber Co., Philadelphia, Pa.
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Schaeffer & Budenberg Mfg. Co., Brooklyn, N. Y. "S. & B."
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Jeffrey Mfg. Co., The, Columbus, Ohio.

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American Engine Co., Bound Brook, N. J.
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Sturtevant Co., B. F., Hyde Park, Mass.
Westinghouse Electric & Mfg. Co., Pittsburgh, Pa.

GOVERNORS, PUMP.

Chaplin Fulton Mfg. Co., Pittsburgh, Pa. "Fulton."
Davis Regulator Co., G. M., Chicago.
Dean Bros. Steam Pump Works, Indianapolis, Ind.
d'Este Co., Julian, Boston, Mass.
Foster Engineering Co., Newark.
Kitts Mfg. Co., Oswego, N. Y.
Monash-Younker Co., Chicago.
"S-C" Regulator Co., The, Fostoria, Ohio.
Squires Co., The C. E., Cleveland.
Strong, Carlisle & Hammond Co., Cleveland, Ohio.
Williams Gauge Co., Pittsburgh, Pa.

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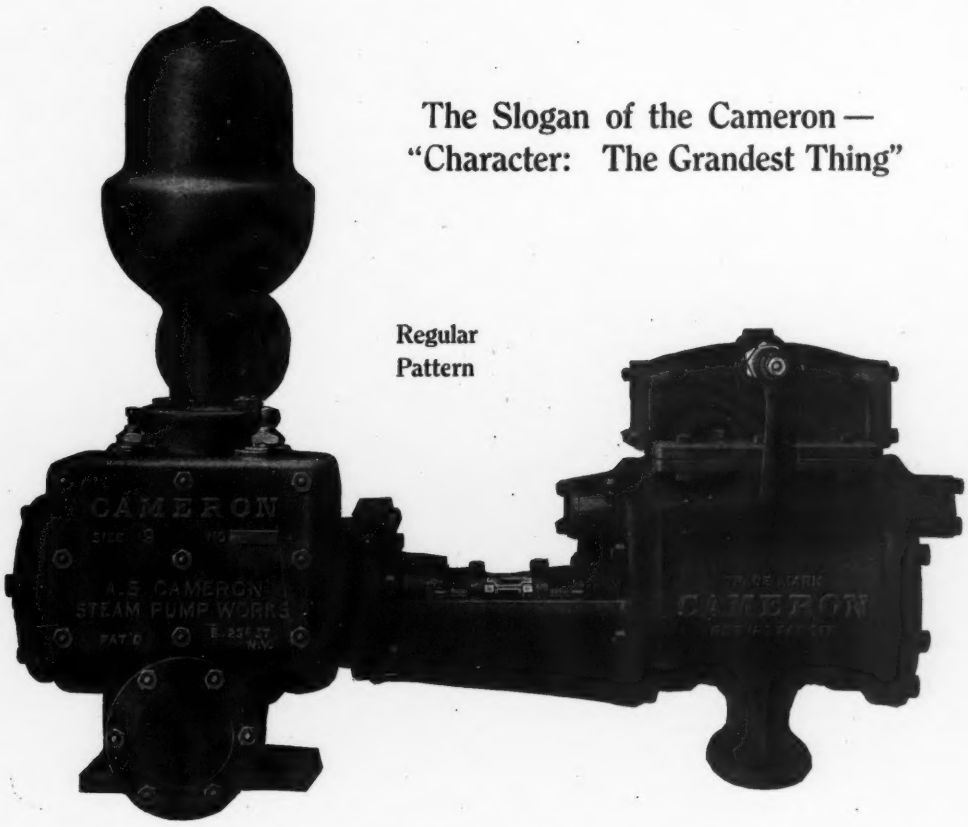

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Foot of East 23rd Street, NEW YORK

Dec., 1911

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Dixon Crucible Co., Jos, Jersey City, N. J. "Ticonderoga."
United States Graphite Co., The Saginaw, Mich.

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Dixon Crucible Co., Jos., Jersey City, N. J.
United States Graphite Co., The, Saginaw, Mich.

GRATES.
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Treadwell & Co., M. H., New York. "Tread-Kill."
Under-Feed Stoker Co., Chicago, Ill. "Jones."
Wickes Boiler Co., Saginaw, Mich.

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Cook's Sons, Adam, New York. "Albany."
Keystone Lubricating Co., Philadelphia, Pa.
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Swain Lubricator Co., Chicago.
United States Graphite Co., Saginaw, Mich.

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Jeffrey Mfg. Co., The, Columbus, Ohio.

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Richardson-Phenix Co., The, Milwaukee, Wis.

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Starrett Co., L. S., Athol, Mass.

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Jenkins Bros., New York. "Sellers."
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Powell Co., The Wm., Cincinnati.
Sherwood Mfg. Co., Buffalo, N. Y.

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Keuffel & Esser Co., Hoboken, N. J.
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Johns-Manville Co., H. W., New York.

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Johns-Manville Co., H. W., New York.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

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United States Graphite Co., Saginaw, Mich.

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Fort Wayne Electric Works, Fort Wayne, Ind. "Wood Systems."
Westinghouse Electric Mfg. Co., Pittsburg, Pa.

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Morse Chain Co., Ithaca, N. Y.

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Albany Lubricating Co., New York, N. Y.
Cook's Sons, Adam, New York, "Albany Grease."
Dearborn Drug & Chemical Works, Chicago, Ill.
Dixon Crucible Co., Jersey City.
Keystone Lubricating Co., Philadelphia, Pa.
Penn Oil and Supply Co., Oil City, Pa.
Standard Oil Co., Inc., New York.
Steel Mill Packing Co., Detroit.
Swain Lubricating Co., Chicago.
United States Graphite Co., The Saginaw, Mich.

LUBRICATING GRAPHITE.
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Essex Brass Co., G. B., Detroit.
Keystone Lubricating Co., Philadelphia, Pa.
Lunkenheimer Co., Cincinnati, O.
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Powell Co., The Wm., Cincinnati, Ohio. "Trojan."
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Sherwood Mfg. Co., Buffalo, N. Y.
Swain Lubricating Co., Chicago.
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York, Mfg. Co., York, Pa.

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Green Fuel Economizer Co., The, Matteawan, N. Y.
Sturtevant Co., B. F., Hyde Park Mass.

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Keystone Lubricating Co., Philadelphia, Pa.
Lunkenheimer Co., Cincinnati, O.
New York and New Jersey Lubricant Co., New York.
Penberthy Injector Co., Detroit.
Powell Co., The Wm., Cincinnati.
Sherwood Mfg. Co., Buffalo, N. Y.
Swain Lubricator Co., Chicago.
Williams Valve Co., D. T., Cincinnati, O.

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Bowser & Co., Inc., S. F., Fort Wayne, Ind.
Burt Mfg. Co., Akron, O.
Lunkenheimer Co., Cincinnati, O.
Manzel Bros. Co., Buffalo, N. Y.
Pittsburgh Gage & Supply Co., Pittsburgh, Pa.
Richardson-Phenix Co., The, Milwaukee, Wis.
Wright Mfg. Co., Detroit, Mich.

OILING SYSTEMS.
Bowser & Co., Inc., S. F., Fort Wayne, Ind.
Pittsburgh Gage & Supply Co., Pittsburgh, Pa. "White-Star."
Richardson-Phenix Co., The, Milwaukee, Wis.

PACKINGS, METALLIC.
Chesterton & Co., A. W., Boston, Mass.
Cincinnati Gasket and Packing Co., Cincinnati, Ohio.
Federal Metallic Packing Co., Boston.
France Packing Co., The, Philadelphia.
Goetze Gasket & Packing Co., New Brunswick, N. J.
Steel Mill Packing Co., Detroit. "Safety."
Von Kokeritz & Co., R. G., New York. "Durabia."

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Carpenter & Co., Geo. B., Chicago. "Rainbow," "Peerless," "Eclipse."
Chesterton & Co., A. W., Boston, Mass.
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Eureka Packing Co., New York.
Federal Metallic Packing Co., Boston.
Gutta Percha & Rubber Mfg. Co., The, New York, N. Y.
N. Y. Belting & Packing Co., Ltd., New York. "Karbonite."
Peerless Rubber Mfg. Co., New York. "Rainbow," "Eclipse."
Quaker City Rubber Co., Philadelphia. "Ebonite," "P. P. P."
Von Kokeritz & Co., R. G., New York. "Durabia."

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Carpenter & Co., Geo. B., Chicago. "Rainbow," "Peerless," "Eclipse."
Chesterton & Co. A. W., Boston, Mass.
Cincinnati Gasket and Packing Co., Cincinnati, O.
Federal Metallic Packing Co., Boston.
Gutta Percha & Rubber Mfg. Co., The, New York.
Jenkins Bros., New York. Jenkins "96."
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Vanda Co., The, New York.
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United States Graphite Co., Saginaw, Mich.

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National Pipe Bending Co., New Haven, Conn.
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PIPE COVERINGS.
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Ashcroft Mfg. Co., The, New York.
Curtis & Curtis Co., Bridgeport, Conn. "Forbes."
Toledo Pipe Threading Mach. Co., The, Toledo, Ohio.
Treadwell & Co., M. H., New York.
Williams & Co., J. H. Brooklyn.

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Armstrong Mfg. Co., Bridgeport.
Borden Co., Warren, O. "Beaver."
Curtis & Curtis Co., Bridgeport, Conn. "Forbes."
Toledo Pipe Threading Mach. Co., The, Toledo, Ohio.
Treadwell & Co., M. H., New York.
Williams & Co., J. H., Brooklyn.

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American District Steam Co., Lockport, N. Y. "Standard."

PIPE, WROUGHT.
National Tube Co., Pittsburgh, Pa.

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Ashcroft Mfg. Co., The, New York.
Ashton Valve Co., Boston, Mass.
Lippincott Steam Specialty & Supply Co., Newark, N. J.
Robertson & Sons, Jas. L., New York. "Willis."
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United States Graphite Co., Saginaw, Mich.

PRESSURE REGULATORS.
Davis Regulator Co., G. M., Chicago.
Dean Bros. Steam Pump Works, Indianapolis, Ind.
d'Este Co., Julian, Boston. "Curtis."
Foster Engineering Co., Newark.
Hughson Steam Specialty Co., Chicago, Ill. "Eclipse."
Monash-Younker Co., Chicago, Ill.
Ohio Brass Co., The, Mansfield, O.
Robertson & Sons, Jas. L., New York.
Squires Co., The C. E., Cleveland.
Strong, Carlisle & Hammond Co., Cleveland, O.
Watson & McDaniel Co., Philadelphia. "McDaniel."

PULLEYS.
American Pulley Co., Philadelphia.
American Well Works, The, Aurora, Ill.
Columbian Rope Co., Auburn, N. Y.
Jeffrey Mfg. Co., The, Columbus, Ohio.

PULLEYS, FRICTION CLUTCH.
American Well Works, The, Aurora, Ill.
Jeffrey Mfg. Co., The, Columbus, Ohio.

PULVERIZERS, COAL.
Jeffrey Mfg. Co., The, Columbus, Ohio.

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American Well Works, The, Aurora, Ill.
McGowan Co., The John H., Cincinnati, Ohio.

PUMPS.
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American Steam Pump Co., Battle Creek, Mich. "Marsh" and "American."
American Well Works, The, Aurora, Ill.
Cameron Steam Pump Works, A. S., New York.
Dean Bros. Steam Pump Works. Indianapolis, Ind.
Deane Steam Pump Co., Holyoke, Mass.
De Laval Steam Turbine Co., Trenton, N. J.
Deming Co., The, Salem, Ohio.

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Most water used by power plants carries in suspension impurities which are harmful to boilers, pumps, condensers, etc. It is easier to keep these impurities out than to repair the damages they would cause. Therefore all power plant water intake lines should contain a Lagonda-Enterprise Multiple Strainer.

These strainers effectually remove all solid matter such as sticks, leaves, fish, lumps of ice, etc. They are easy to install, can be cleaned while in operation, are suitable for either suction or pressure lines and are guaranteed to be tight under either condition. Can be set in any position and used inside or outside of the building.

They are handier and more effective than boxes or wire netting placed at the water intakes as they can be easily cleaned without interrupting the flow of water.

Many other good points that you should know about these strainers are mentioned in Booklet R. Write for copy to-day.

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Makers of Weinland Boiler Tube Cleaners, Automatic Cut-off Valves, Reseating Machines, Boiler Tube Cutters and Water Strainers. 168

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Stewart Heater Co., Buffalo, N. Y.
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Alberger Pump Co., New York.
American Steam Pump Co., Battle Creek, Mich. "Marsh" and "American."
American Well Works, The, Aurora, Ill.
Cameron Steam Pump Works, A. S., New York, N. Y.
De Laval Steam Turbine Co., Trenton, N. J.
Dean Bros., Steam Pump Works, Indianapolis, Ind.
Deane Steam Pump Co., Holyoke, Mass.
Goulds Mfg. Co., Seneca Falls, N. Y.
McGowan Co., The John H., Cincinnati, Ohio.

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American Well Works, The, Aurora, Ill.
Alberger Pump Co., New York.
Cameron Steam Pump Works, A. S., New York.
Deane Steam Pump Co., Holyoke, Mass.
De Laval Steam Turbine Co., Trenton, N. J.
Goulds Mfg. Co., Seneca Falls.
Morris Machine Wks., Baldwinville, N. Y.

PUMPS, COMPOUND.
American Steam Pump Co., Battle Creek, Mich. "American."
Cameron Steam Pump Works, New York.
Dean Bros. Steam Pump Works, Indianapolis, Ind.
Deane Steam Pump Co., Holyoke, Mass.
McGowan Co., The John H., Cincinnati, Ohio.

PUMPS, CONDENSER
McGowan Co., The John H., Cincinnati, Ohio.

PUMPS, DEEP WELL.
American Steam Pump Co., Battle Creek, Mich. "Marsh."
American Well Works, The, Aurora, Ill.
Cameron Steam Pump Works, A. S., New York.
Dean Bros. Steam Pump Works, Indianapolis, Ind.
Deane Steam Pump Co., Holyoke, Mass.
Deming Co., The, Salem, Ohio.
Goulds Mfg. Co., Seneca Falls, N. Y.
McGowan Co., The John H., Cincinnati, Ohio.

PUMPS, ELEVATORS AND FIRE.
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Cameron Steam Pump Works, A. S., New York.
Deane Steam Pump Co., Holyoke, Mass.
Goulds Mfg. Co., Seneca Falls.
McGowan Co., The John H., Cincinnati, Ohio.

PUMPS, GRAPHITE.
Richardson-Phenix Co., The, Milwaukee, Wis.

PUMPS, GREASE.
Richardson-Phenix Co., The, Milwaukee, Wis.

PUMPS, HYDRAULIC PRESSURE.
American Steam Pump Co., Battle Creek, Mich. "Marsh."
American Well Works, The, Aurora, Ill.
Cameron Steam Pump Works, A. S., New York.
Deane Steam Pump Co., Holyoke, Mass.
Goulds Mfg. Co., Seneca Falls.
McGowan Co., The John H., Cincinnati, Ohio.

PUMPS, JET.
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Cameron Steam Pump Works, A. S., New York.
Hancock Inspirator Co., The, New York, N. Y.
Hayden & Derby Mfg. Co., The, New York, N. Y.

PUMPS, OIL.
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Detroit Lubricator Co., Detroit.
Lunkenheimer Co., Cincinnati, O.
Manzel Bros. Co., Buffalo, N. Y.
McCord Mfg. Co., Detroit, Mich.
Penberthy Injector Co., Detroit.
Powell Co., The, Cincinnati, O.
Pittsburgh Gage & Supply Co., Pittsburgh, Pa.
Richardson-Phenix Co., The, Milwaukee.
Sherwood Mfg. Co., Buffalo, N. Y. "Hart."
Williams Valve Co., D. T., Cincinnati, O.

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American Steam Pump Co., Battle Creek, Mich. "Marsh," and "American."
American Well Works, The, Aurora, Ill.
Cameron Steam Pump Works, A. S., New York.
Worthington, Henry R., New York, N. Y.

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American Steam Pump Co., Battle Creek, Mich. "Marsh."
American Well Works, The, Aurora, Ill.
Cameron Steam Pump Works, A. S., New York.
Deane Steam Pump Co., Holyoke, Mass.
Goulds Mfg. Co., Seneca Falls, N. Y.

PUMPS, STEAM.
American Steam Pump Co., Battle Creek, Mich. "Marsh" and "American."
American Well Works, The, Aurora, Ill.
Cameron Steam Pump Works, A. S., New York.

PUMPS, VACUUM.
Alberger Pump Co., New York.
American Steam Pump Co., Battle Creek, Mich. "Marsh."
Bury Compressor Co., Erie, Pa.
Cameron Steam Pump Works, A. S., New York.
Dean Bros. Steam Pump Works, Indianapolis, Ind.
Goulds Mfg. Co., Seneca Falls, N. Y.
McGowan Co., The John H., Cincinnati, Ohio.
Worthington, Henry R., New York, N. Y.

PURIFIERS.
Harrison Safety Boiler Works, Philadelphia, Pa.
Hoppes Mfg. Co., Springfield, O.

PYROMETERS.
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Bristol Co., Waterbury, Conn.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N. Y.

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Robertson & Sons, Jas. L., New York. "Victor."

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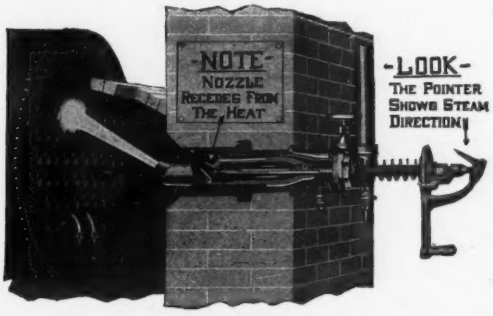

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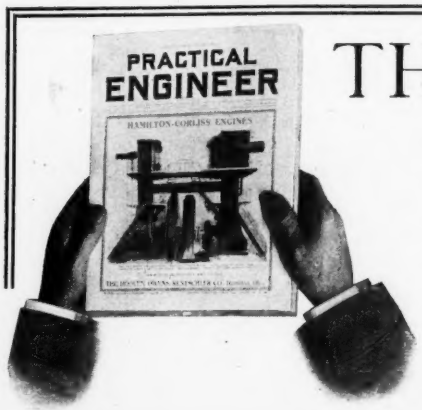

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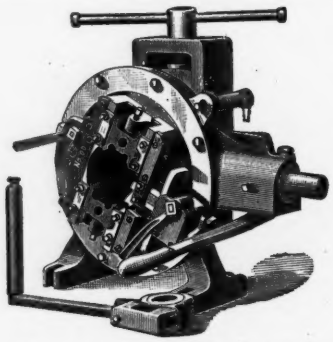

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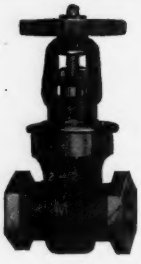

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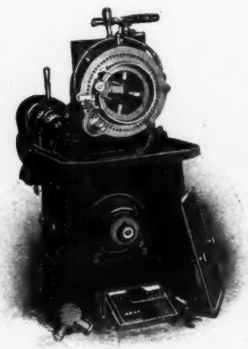
IDEAL WRENCH

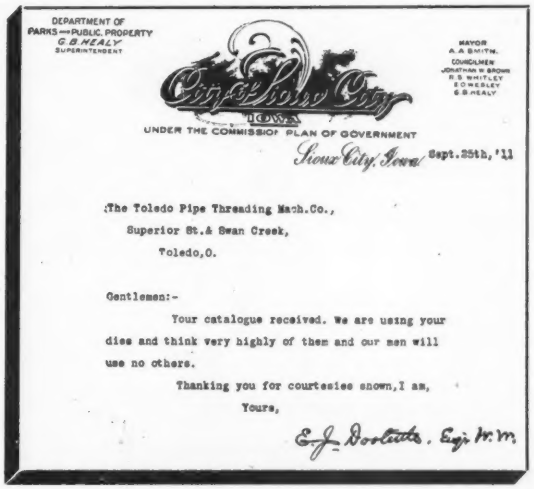
Forbes

An Electric Driven Pipe Machine



Speed, Accuracy, and Durability are the prime necessities of a Pipe Machine. These features are realized in the **"FORBES"** as well as others which are fully described in our new Catalogue.

The Curtis & Curtis Co.
53 Garden Street, Bridgeport, Conn., U. S. A.



DEPARTMENT OF PARKS — PUBLIC PROPERTY
G. B. HEALY, SUPERINTENDENT

City of Sioux City
IOWA
UNDER THE COMMISSION PLAN OF GOVERNMENT

MAYOR A. A. SMITH.
COUNCILMEN JONATHAN W. BROWN, R. S. WHITLEY, E. O. MEDLEY, G. B. HEALY

Sioux City, Iowa, Sept. 25th, '11

The Toledo Pipe Threading Mach.Co.,
Superior St.& Swan Creek,
Toledo,O.

Gentlemen:-

Your catalogue received. We are using your dies and think very highly of them and our men will use no others.

Thanking you for courtesies shown, I am,

Yours,

E. J. Doolittle, Eng. W. W.

The Engineer of the Sioux City Water Works wrote this letter voluntarily, and it merely shows how "Toledos" are looked upon by their owners. If you want perfection in pipe threading, then you want a "Toledo" Pipe Threader.

Write for "A Pipe Threading Miracle."

THE TOLEDO PIPE THREADING MACHINE CO.
TOLEDO, OHIO

"Angle or Globe" **"AUTOMATIC"**
Cushioned Non-Return and Triple Acting
VALVES
"Work Both Ways"

Close automatically and prevent injury to employees, and prevent costly shut-downs of plant, should a break occur anywhere in a boiler or in the steam line.

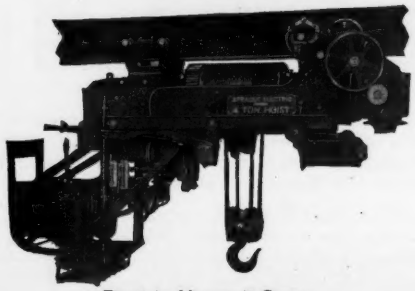
Largest Steam users in the World ordered 997 Valves for the protection of their power Stations.
Automatic Steam and Water Controlling Valves.
Steam and Water Reducing Valves.

Write for New Catalogue

Golden-Anderson Valve Specialty Company
1012 FULTON BUILDING, PITTSBURGH, PA.

SPRAGUE ELECTRIC HOISTS

FOR THE QUICK AND EFFICIENT HANDLING OF ALL LOADS



Electric Monorail Crane
Four, Five and Six Tons Capacity

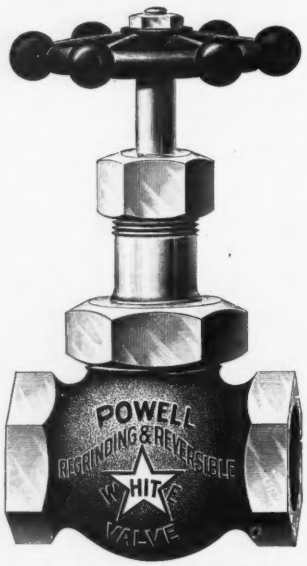
Do not waste valuable time in the manual handling of loads. A Sprague Hoist will do the work efficiently and in a fraction of the time. An invaluable aid to scientific management.

Let our experts furnish you with equipment specifications free of obligation on your part.

Descriptive Pamphlet No. 23369 Sent on request

Monorail Cranes · Electric Shovels · Electric Winches

SPRAGUE ELECTRIC WORKS
OF GENERAL ELECTRIC COMPANY
Main Offices: 527-531 West 34th Street, New York City
Branch Offices in Principal Cities



The Powell
White Star Valve
is specified by Engineers for its
Efficiency

For Instance,

if you have to rip out your pipe line to replace a leaky or worn out valve, you don't get efficiency from the body of the valve. The disc, or the seat, or both, have worn out before the other parts of the valve have even shown signs of service.

Therefore,

by installing a POWELL White Star Valve, you get efficiency of service from ALL parts. You can replace the disc, or the seat, or both, when necessary, and keep on doing so until all parts are worn out with a minimum of trouble and expense,

Here is Our Guarantee:

Try a POWELL White Star Valve in the hardest place. If it doesn't make good—your money back without a quibble.

Ask your jobber—HE knows. If he can't supply you, we will.

THE WM. POWELL CO.

DEPENDABLE ENGINEERING SPECIALTIES.

CINCINNATI

BRONZE TO BRONZE

That's the Secret

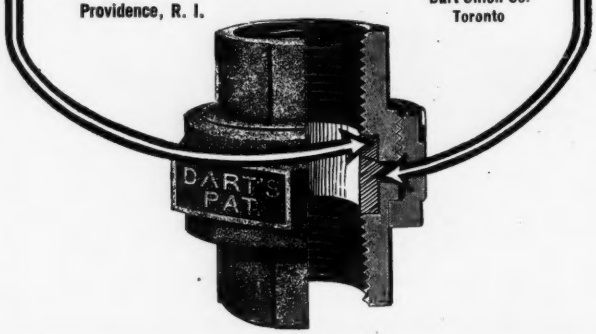
of the Dart Union's superiority. This Bronze to Bronze construction gives **double** assurance of a perfectly and permanently tight joint. It's insurance against rust and corrosion. It makes the **Dart** Union a **whole** union, instead of half a union. And it not only cuts your union costs by the year but makes a big difference in the **labor** cost of keeping your steam lines tight and right. Pipe threads are "standard," and straightway through the union. The pipe ends are of heavy malleable iron.

Judge unions as you judge men—by what they do.

We'll send you samples of Dart Unions for actual test. No charge.

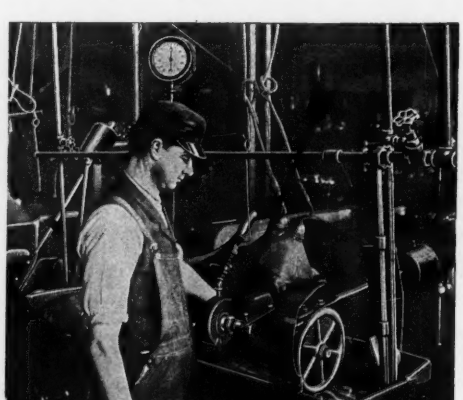
E. M. DART MFG. CO.
Providence, R. I.

Canadian Factory:
Dart Union Co.
Toronto



TESTING

"KEWANEE" UNIONS.



125 pounds compressed air pressure under water.

¶ **Every individual union is subjected to this test practically twice, and if any imperfection appears the union is scrapped.**

¶ Don't be troubled with leaky unions—insist on getting the "leakless" union—the **"Kewanee" Union.**

National Tube Company

General Sales Offices, Frick Building, Pittsburgh, Pa.

District Sales Offices: Atlanta Chicago Denver New Orleans New York Philadelphia Pittsburgh St. Louis Salt Lake City

Pacific Coast Representatives: U. S. Steel Products Co. San Francisco Seattle Portland Los Angeles

Export Representatives: U. S. Steel Products Co., New York City

Be Sure to Look for the Name "Jefferson" Cast on the Upper Side of the Nut

That is your protection against the substitution of inferior unions—your guarantee of the service and all around satisfaction that only the *Jefferson* Union can give. No union without the name "Jefferson" on the nut is a genuine Jefferson Union or contains any of the many patented features of the "Jefferson."

The Name "Jefferson" on the Nut of a Union is an Absolute Guarantee of Satisfactory and Economical Service. . . .

It Will Pay You to Remember

That the Jefferson Union has the smallest amount of Brass to be found in any two-metaled union, and that the Brass, made of *drawn tubing*, sets back, away from the runway of the pipe and contact with its contents.

That this brass is imbedded in the iron—held securely on three sides, and that the wide shoulder which separates it from the runway of the pipe also helps to equalize and minimize the contraction and expansion between the iron and the brass.

That the *upper* part of the shoulder, on the male member, is *rounded*, not squared, where it comes in contact with the nut, and that the surface of the nut also is rounded at that point. That the nut fits the male (upper) member loosely, *except* on the shoulder. All of which will impress you more sometime when you are making a joint between pipes that are out of line—when you need that "play" which you find in no other union.

And then it will pay you to remember that the Jefferson Union has a *Ball*-shaped joint—correct in principle, and far superior to the usual conical joint.

That the nut threads are coarse enough to permit easy adjustment and are coated with graphite, which lubricates, prevents corrosion and makes it easy to break the joint if necessary.

That the pipe ends are *taper* tapped, conforming to Briggs' Standard.

That the pipe ends are of malleable iron, eliminating the "stretch" which is always found in brass.

That the Jefferson Union is the handiest, most lasting and generally satisfactory union that money can buy.

Mail the Coupon

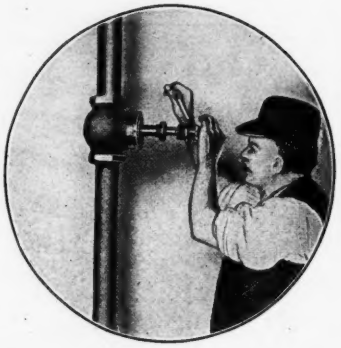
to us today, and get the *whole* story, with clear illustrations, in our Free Catalog "A." Then, when you've read of the other Jefferson Union Efficiency Points, send to us for a Jefferson Union (free) and give it an actual *test*, checking it up against our claims. That will settle this big, important question of which union *you* want—settle it once and for all time. Use the Coupon—now.

THE JEFFERSON UNION COMPANY P.E.
Lexington, Mass.
Gentlemen: Please send me Free Catalog "A."
Name .....
Address .....
Company Name .....

Jefferson Union Company Main Street Lexington, Mass.

Put Those Old Valves Back Into the Line and Keep Them There Till They're Really Worn Out

THERE are few concerns so big and prosperous that they can afford to throw out a lot of valves that have given only one-tenth to one-twentieth of their possible service, to say nothing of wasting the time required for replacing valves only partially worn with brand new ones. You know a valve isn't necessarily worn out because it leaks. You know that, generally, only the **seats** are worn.



The Dexter Valve Reseating Outfit Will Reseat and Renew the Same Valve Ten Times

—as many as twenty times, if it's a flat seat valve. So, when you discard a valve the first time it leaks, you're actually **throwing away** 90% or more of its cost. And that runs into money in the course of a year.

You take the Dexter Outfit right to the job. **One** man does the work and does it perfectly—in a **few minutes.**

There's no tugging on wrenches—no loosening of joints to make trouble later on. You don't even break the joint where the valve is. You leave the valve right there while you reseat it. There's no chance to go wrong. You simply attach the jaws of the universal chuck to the valve casing, give the handle a few turns, put the valve stem back and you're through. The tool shaft is self-aligned and you can't get anything but a **perfect** job.

But the Best Proof is a Thirty Days' Trial at Our Expense —our offer to every concern that has a satisfactory rating

We ask no other favor for the Dexter Outfit—just a thorough trial—right on your own valves—right "in the line."

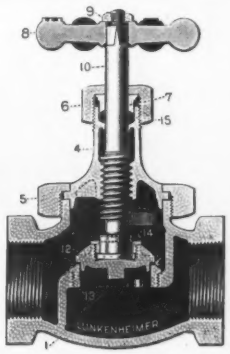
If you can save a good part of the cost of the outfit by renewing your old valves during the trial, help yourself—go as far as you like. And, even then, after the Dexter Outfit has **proved** its case beyond dispute, you can send it back **at our expense** if you think you can **afford** to.

Now, then, it's just a question as to whether you are **willing** to save time and money on repairs and replacements and cut your valve bills at the same time—after you've had the **proof,** without any risk or expense on your part, that you **can** do it.

You'll want our Illustrated Catalog T-15. There is a copy now ready. How shall we address it?

THE LEAVITT MACHINE CO., Orange, Mass., U. S. A.

Lunkenheimer "RENEWO" Valve



What the "RENEWO" is

A valve that remains tight longer than any other. Should it ever leak, it can be repaired without any expense other than a slight amount of labor necessary to RENEW the seating surfaces. If any part (no matter what) is damaged or worn, it can be RENEWED with little labor or expense. This must be conceded by anyone having had even the slightest experience in the use of valves as the attainment of VALVE PERFECTION, or as nearly so as is possible.

Why the "RENEWO" is Properly Called "Valve Perfection"

BECAUSE it is so designed that it is practically indestructible. BECAUSE only the highest grade of bronze and nickel composition is used, insuring its durability. BECAUSE it is made by skilled mechanics in the most up-to-date valve factory in the world. BECAUSE the rigid inspection system controlling every item of its manufacture from the receipt of the raw materials up to the very minute the finished valve leaves the factory, insures as perfect a product as any human agency can develop. And BECAUSE it is made by THE LUNKENHEIMER COMPANY, and is the result of half a century's experience in valve design and manufacture.

IMPORTANT DETAILS OF CONSTRUCTION

PRESERVATION OF SEATING SURFACES. The greatest wear on the seating surfaces of a valve, caused by the tremendous velocity of the steam, takes place when the valve is nearly closed. To reduce this wear, the disc in the "Renewo" valve is provided with a projecting lip on the bottom, which enters the seat ring at the proper time, and permits only a very fine spray to flow between the seating surfaces. This spray thoroughly cleanses these parts, removing any dirt or grit that may have lodged on them, thereby preventing them from becoming marred when the valve is tightly closed.

SEATING SURFACES REGRINDABLE. Should the seating surfaces become worn they can be quickly and easily renewed repeatedly without purchasing new parts or necessitating the removal of the valve from the connecting pipes.

ALL PARTS RENEWABLE. This refers to every part of the valve, making the "Renewo" practically indestructible, and presenting a valve that will last as long as its connecting pipe.

MATERIAL. The Lunkenheimer "Renewo" valve is much heavier than any competing article, which means more metal, and consequently greater strength, and it will safely withstand the pressure for which it is guaranteed.

The high-grade bronze used contains a high percentage of copper and tin and it is made to our own formula, the composition varying according to the location of the valve and the duty of the various parts.

The renewable seat ring is made of a hard close-grained nickel composition, the very best material obtainable for the purpose.

WORKMANSHIP. The elegant and finished appearance of the "Renewo" valve shows at a glance the very highest type of workmanship. Only skilled mechanics are employed and aided by machinery of special design, the accurate and rapid production of the valve is insured.

VARIOUS PATTERNS AND SIZES. The "Renewo" is made in two weights, known as the medium and extra heavy patterns. The medium pattern is guaranteed for working pressures up to 200 pounds per square inch, and the extra heavy pattern for 300 pounds. Every valve is tested under conditions more severe than occur in practice at these pressures and therefore we can safely guarantee its use. The valve is made in sizes ranging from ¼ to 3 inches inclusive.

"MOST supply houses sell them—yours CAN—if they DONT or WONT—tell US."

THE LUNKENHEIMER CO.

169 E

Largest Manufacturers of High-Grade Engineering Specialties in the World

General Offices and Works: CINCINNATI, OHIO, U. S. A.

NEW YORK	CHICAGO	BOSTON	LONDON, S. E.
64-68 Fulton St.	186 N. Dearborn St.	138 High St.	35 Great Dover St.

NELSON Blow-off Valve

TRADE-MARK REGISTERED

Seatless Fool-proof Guaranteed

Valve cannot be opened suddenly; slow opening prevents sudden and excessive water hammer.

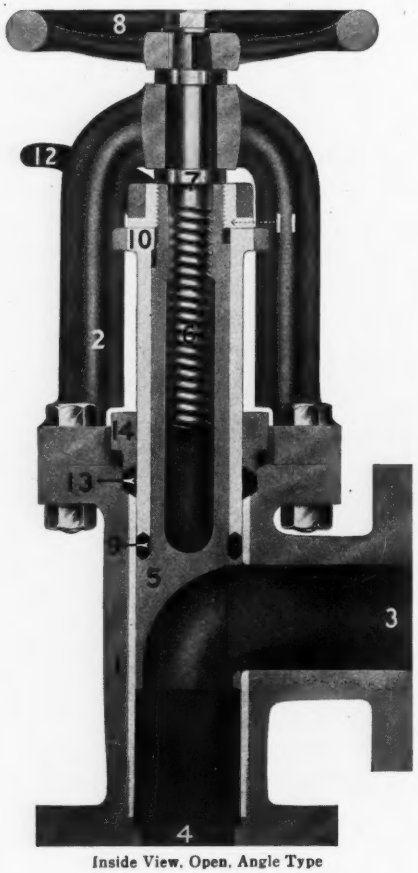
Because the Yoke (2) is firmly bolted to the Body (1) the Plunger is always perfectly in line. This lets the plunger slide freely, makes the stem operate easily. No sticking—no jam.

Bronze stem (6) has threads cut accurately, specially adapted to the valve's duty; the Collar (7) is cast solidly on this stem, it cannot work loose.

The stem revolves in the Plunger, composed of Piston (5) and Bronze Sleeve (10) which slides freely, in the bronze-lined Body (1).

Lever wrench (12) (see it better on outside view below) engages with Nut (11). This compresses Sleeve (10) on Packing Ring (9), adjusting it to a nicety, when the valve is closed. This wrench cannot be removed from the valve or lost, but can easily be lifted from the nut to get a new "bite."

Packing (13) is compressed by Bolted Gland (14) (more clearly seen on outside view). This packing is adjusted altogether independently of lower packing (9). Both adjustments are positive, the packing is held securely, practically indestructible, cannot be blown out.



Inside View, Open, Angle Type

When the valve is wide open, the plunger strikes collar (7); when valve is closed the plunger strikes the projection (4) at outlet on the bottom. These limit positively the travel of the plunger either way. The plunger is always in sight; you can always see if the valve is open, partly open or closed.

When open, the passage through the valve is as clear and as easy as through a regular ell; little friction; no obstructions, no pockets; scale cannot accumulate; nothing to wear or get out of order.

No stem packing required. No gasket between yoke and body of valve, because packing (13) prevents leakage there.

No seats. No discs.

Wire drawing impossible.

The plunger when closed, presents a bronze face to the fluid and scale it holds back. The slight wear at this point does no harm because the packing both above and below the inlet holds tight the fluid. When open the velocity is directed against the curved end of the plunger, which it cannot damage.

Outside View

Sizes 1½", 2", 2½" and 3". Iron Body, for 300 pounds working pressure, Steel for extreme service. Also made in Straightway Type, same sizes, iron or steel.

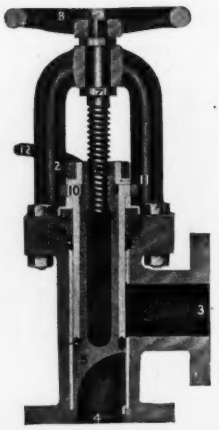
Guarantee

We guarantee the **NELSON** Blow-off Valve. It is patented. Its name is trade-marked. We couldn't afford to put our name on it if it was not right. If, after 60 days of use, you are not satisfied, send back the valve and we will refund the price you paid for it. Could we make you a better or more reasonable offer than that?

Nelson Valve Company

Philadelphia

NEW YORK, 30 Church Street
CHICAGO, 17 West Kinzie Street
SAN FRANCISCO, 22 Battery Street
PITTSBURGH, 517 Liberty Avenue
MINNEAPOLIS, 622 Andrus Building
BUTTE, MONT., 56 East Broadway
MONTREAL, 12 14 University Street


Inside View, Closed

The NELSON Blow-off Valve

TRADE-MARK REGISTERED

is the one you've been hunting for many a day.

For—it has no seats to score; no discs or plugs to wear out; no pockets or places for scale to collect.

Wire-drawing impossible. Tight all the time except when open. Easiest flow possible.

Simple and strong, yet easily operated; no sticking, no jam.

Violence of pressure attacks only curved end of plunger, which it can't harm.

Why Other Types Failed

The various types of Globe Valves, Angle Valves, Gate Valves and Ground Cocks have proven totally deficient when used for blow off-purposes.

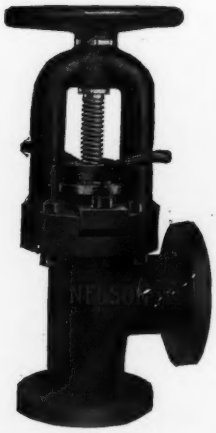
The *globe and angle valve discs quickly wear*, and the continual replacements and repairs, together with troublesome leakage, mean loss and difficulty from the moment you put in the valve until you decide to throw it away.

No gate valve will stand the terrific cutting action of the dirt or scale; *cocks leak* when they don't jam, *and jam* when they don't leak; and you know how the discharge of particles and scale cuts away that beautifully-ground cock joint until it looks like a bastard thread attacked by a sand-blast.

The Best Thing To Do

If you are planning a new power plant you will not hesitate to order the **NELSON** Blow-off Valve, that has no seats, no discs, no taper joints, nothing to get out of order; a source of satisfaction and economy during the entire life-time of your plant.

And you can't do a better thing than to *replace your present worn and leaky* blow-off valves with the **NELSON**—it will put an end to your blow-off valve worry and will save you its cost eventually.



Outside View

Mail the coupon, and get the catalogue and prices. Remember! The Nelson Blow-off Valve is guaranteed. When you order one, you are not obliged to keep it—but we know you won't part with it after you once see it and try it.

Nelson Valve Company,
Chestnut Hill, Philadelphia, Pa.

Please send me catalogue and prices of NELSON Blow-off Valves.

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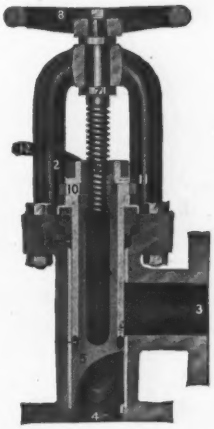
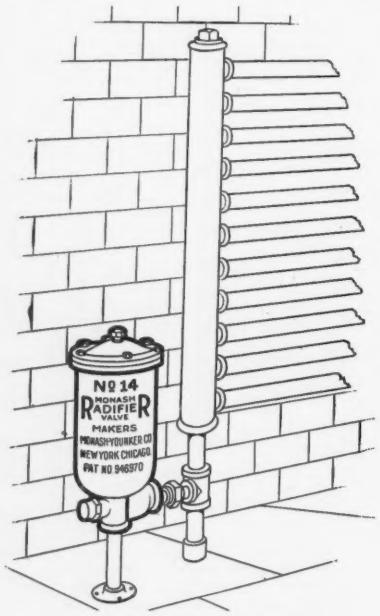


Inside View, Closed

Economy In A Power Plant



Showing application of Monash Noiseless Radifier to return end of coils

Should cover not only the original cost of installation and saving in fuel, but should also be applied towards utilizing all the available exhaust steam of every heating device and in obtaining the highest efficiency throughout the entire system.

The installation of the MONASH NOISELESS SYSTEM of Vacuum Heating insures an even, perfectly controlled temperature at all times and for all purposes.

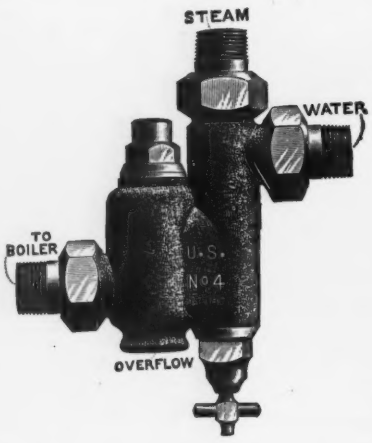
The special feature of this system is the valve attached to the return end of radiators or coils, the MONASH NOISELESS RADIFIER — an absolutely Noiseless, Non-Thermostatic, Non-Adjustable, Positively Automatic Valve; operating on any heating device where a Vacuum Pump is employed on the return pipe. The only valve on the market so constructed that it is impossible for grease or dirt to accumulate.

THE MONASH NOISELESS SYSTEM

Can be installed by any Heating Engineer.

Write for our latest Catalogue

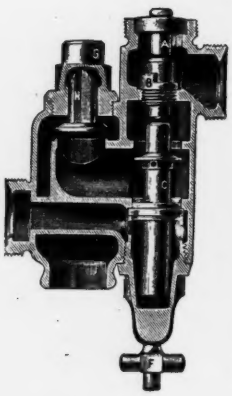
NEW YORK **MONASH-YOUNKER CO.** CHICAGO



We Want Engineers

all over the country to investigate, to study, to test

United States Automatic Injectors



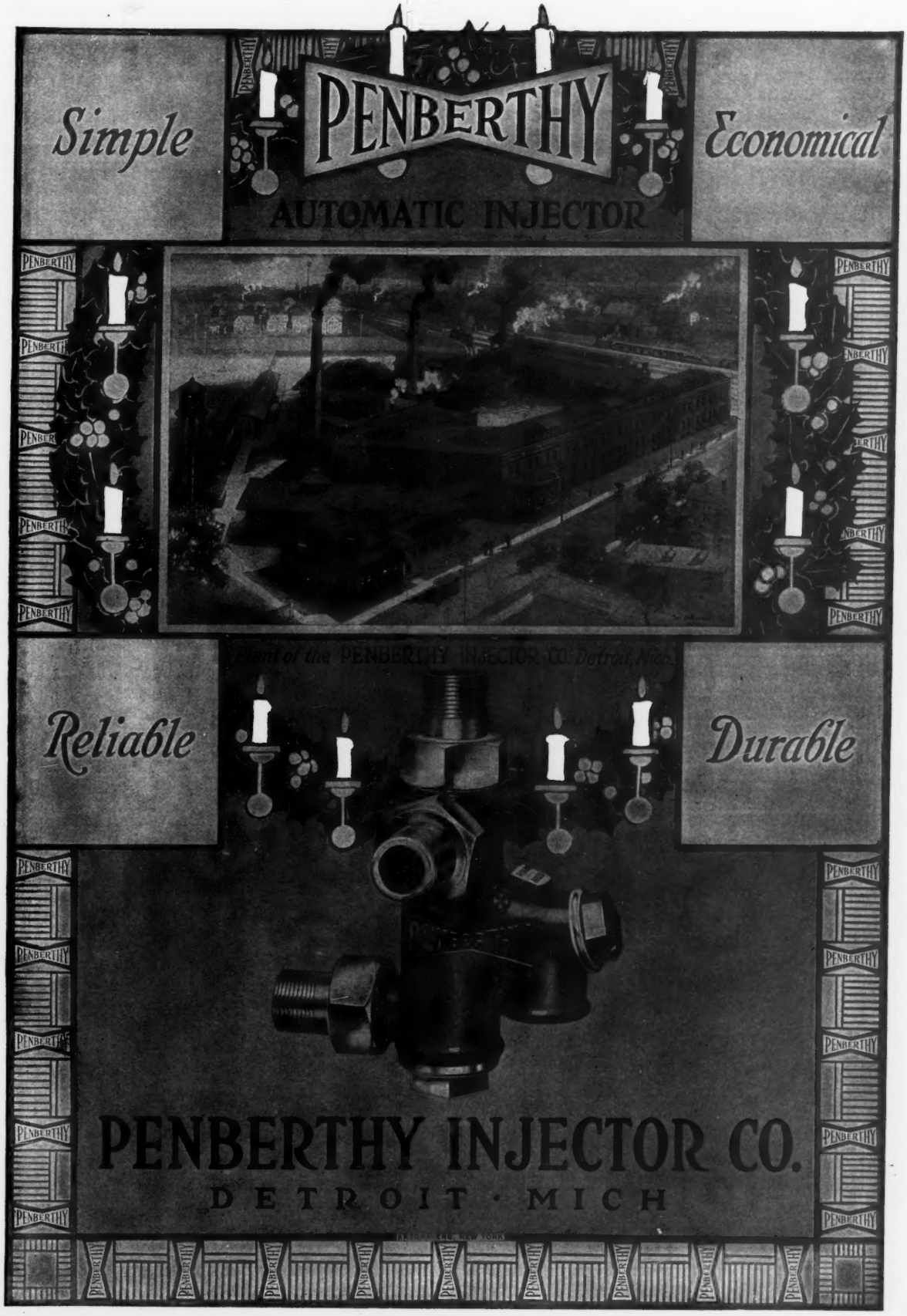
Their absolute dependableness is attested by the fact that they have met the requirements of Government specifications and are in use in thousands of Government Plants throughout the country.

U. S. Automatic Injectors feed hotter water to the boiler, start at lower steam and work to higher steam than any other and they enable the engineer to get the best and most dependable service out of a boiler at the least cost.

Send for Catalog "H." Study the construction. Note the valves. You'll understand why they save money; why they wear longer, why they give greater efficiency with less trouble than any other injector made. Write today. And while you're writing ask for our "Engineer's Red Book." It's full of useful information.

American Injector Company

Detroit, 180 Fourteenth Ave., Michigan


Simple
PENBERTHY
AUTOMATIC INJECTOR
Economical
Plant of the PENBERTHY INJECTOR CO. Detroit, Mich.
Reliable
Durable
PENBERTHY INJECTOR CO.
DETROIT · MICH

Dearborn Treatment

Prevents all Boiler Feed Water Troubles

A quarter century's success demonstrates Dearborn Treatment to be absolutely ***right*** in both principle and application.

Thousands of power users throughout the world acknowledge the superiority of scientific methods of treating boiler feed water troubles, by using Dearborn Treatment exclusively.

We will advise you of the most practical way to cure your feed water troubles if you will send us a gallon of the water used.

Dearborn Drug & Chemical Works

Robert F. Carr, President

General Offices, Laboratories and Works, Chicago
General Eastern Offices, 299 Broadway, New York

Branch Offices in Principal Cities of U. S.

Foreign Branches and Agencies: {Honolulu, Havana, Tokio, Manilla, Hongkong. Shanghai, Tientsin, Tsingtau

UNIVERSAL SERVICE

Is Your Feed Water Fit For Use?

THE BIRD-ARCHER COMPANY'S BOILER COMPOUNDS
90 WEST ST. TRADE MARK NEW YORK

Send Us A Sample Gallon For Analysis

You wouldn't think of drinking impure water yourself, why feed such water to your boilers?

But you say: "I have no way of making sure whether our feed water is right or not!" We have—analyzing feed water is our specialty. And while we cannot change the WATER you must use, we can purify it with our boiler compounds and change its chemical action upon your boilers.

We CAN put a stop to the formation of scale and corrosion. Bird-Archer Boiler Compounds are made for that very purpose.

And they are made RIGHT, because we never make up our compounds for you, until we know the exact nature of your feed water. Like made-to-measure clothing, Bird-Archer Boiler Compounds are made to FIT the peculiar requirements of your OWN INDIVIDUAL CASE.

All ready-made boiler compounds differ from

Bird-Archer Boiler Compounds

in this respect. Why waste money experimenting with them?

You run no risk when you use our compounds, because we give you an iron-clad guarantee—they must remove and prevent scale and corrosion. Isn't a gallon of prevention better than a barrel of cure? Had you not rather ward a cold off than to get sick and have to doctor it away?

Think the matter over and while you are thinking about it, don't forget to send us a gallon jug of your feed water for analysis. Our Analytical Chemist will examine it carefully, submit a report of the scale-forming elements it contains and write out a prescription that will cure every unfavorable condition found. And just as individual doctoring is best for sick people, so is it best for "sick boilers." But doctor in time.

Our Treatise—"Boiler Troubles and their Prevention" will be sent free upon receipt of your name and address.

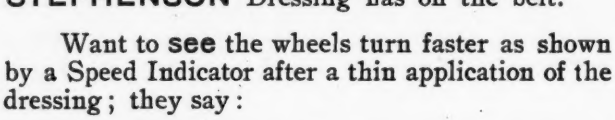
The Bird-Archer Company, 90 West Street NEW YORK

This Registered Trade-Mark is Your Protection. Look for it on Every Pound Stick of Belt Dressing That Comes Into Your Place.

"I'M FROM MISSOURI— SHOW ME"

In effect this is what men say who write us for a

FREE HALF-POUND SAMPLE OF



They want to be **shown**—

Want to see for **themselves** what effect **STEPHENSON** Dressing has on the belt.

Want to **see** the wheels turn faster as shown by a Speed Indicator after a thin application of the dressing; they say:

"Show me" that one pound of **STEPHENSON** lasts as long as two pounds of the old-fashioned liquid or semi-liquid dressings.

"Show me" that it is handier and better than what I am using.

Our FREE HALF-POUND SAMPLE does this—wipes out false claims—overcomes prejudice—opens men's eyes—makes new friends for **STEPHENSON** BAR BELT DRESSING.

Let us have **your** name and address so that we can show **you** with a free **HALF-POUND SAMPLE**—and say which—

RED Label for Leather—
GREEN Label for Rubber, Canvas, or Balata—

No **one** kind is good for **all** belts—you know that.

In every city in this country, **STEPHENSON** is carried in stock by wide-awake mill supply people. Be sure they send you the **GENUINE**—

Look for the TRADE-MARK

STEPHENSON MFG. CO.

Est. 1888 **ALBANY, N. Y.** Inc. 1897

These tables contain data especially worked out or carefully selected that are vital to your work. You may need them at any time and should preserve them. A handy, serviceable, loose-leaf cover in which these tables fit exactly, will be sent you for 30 cents in currency or stamps. Or the loose-leaf cover with a two-year subscription to Practical Engineer at $1.75.

PROPERTIES OF SATURATED STEAM

Pressure lb. per sq. in. Absolute	Pressure lb. per sq. in. Gage	Temperature Deg. F.	Heat from 32 deg. F., B. t. u. In Liquid	Heat from 32 deg. F., B. t. u. Total in Steam	Latent Heat of Vaporization B. t. u.	Weight lb. per cu. ft. of Steam	Vol. cu. ft. per lb. Steam
15.5	0.5	214.8	183.8	1146.9	963.3	0.0399	25.15
16.	1.	216.3	185.3	1147.4	962.1	0.0411	24.32
16.5	1.5	217.9	187.0	1147.9	961.0	0.0424	23.55
17.	2.	219.4	188.4	1148.3	959.8	0.0435	22.96
17.5	2.5	220.9	190.0	1148.9	958.7	0.0448	22.35
18.	3.	222.4	191.4	1149.2	957.7	0.0459	21.78
18.5	3.5	223.9	192.9	1149.7	956.7	0.0471	21.20
19.	4.	225.2	194.3	1150.1	955.7	0.0483	20.70
19.5	4.5	226.7	195.5	1150.6	954.7	0.0495	20.15
20.	5.	227.9	197.0	1150.9	953.8	0.0507	19.72
20,5	5.5	229.4	198.4	1151.3	952.8	0.0519	19.30
21.	6.	230.5	199.7	1151.7	951.9	0.0531	18.84
21.5	6.5	231.9	200.8	1152.1	951.0	0.0542	18.45
22.	7.	233.0	202.2	1152.5	949.9	0.0555	18.03
22.5	7.5	234.2	203.4	1152.9	949.3	0.0565	17.65
23.	8.	235.4	204.7	1153.2	948.5	0.0580	17.26
23.5	8.5	236.7	205.9	1153.6	947.6	0.0590	16.95
24.	9.	237.8	207.	1153.9	946.9	0.0601	16.64
24.5	9.5	238.9	208.7	1154.2	946.1	0.0613	16.26
25.	10.	240.1	209.3	1154.6	945.3	0.0625	15.99
26.	11.	242.3	211.5	1155.3	943.7	0.0650	15.38
27.	12.	244.4	213.7	1155.8	942.2	0.0673	14.86
28.	13.	246.4	215.7	1156.4	940.8	0.0696	14.37
29.	14.	248.4	217.8	1157.1	939.4	0.0719	13.90
30.	15.	250.4	219.7	1157.8	937.9	0.0743	13.46
31.	16.	252.2	221.6	1158.4	936.7	0.0766	13.05
32.	17.	254.1	223.5	1158.9	935.3	0.0789	12.67
33.	18.	255.9	225.3	1159.5	934.0	0.0812	12.31
34.	19.	257.6	227.1	1160.0	932.8	0.0835	11.97
35.	20.	259.3	228.8	1160.5	931.6	0.0858	11.65
40.	25.	267.3	239.9	1162.9	926.0	0.0974	10.27
45.	30.	274.4	244.3	1165.1	920.9	0.1089	9.18
50.	35.	281.0	251.0	1167.1	916.3	0.1202	8.31
55.	40.	286.9	257.2	1168.9	912.0	0.1314	7.60
60.	45.	292.7	262.9	1170.7	908.0	0.1425	7.01
65	50.	297.8	268.3	1172.3	904.3	0.1538	6.51
70.	55.	302.9	273.4	1173.8	900.8	0.1648	6.07
75.	60.	307.4	278.2	1175.2	897.4	0.1759	5.69
80.	65.	312.0	282.7	1176.5	894.3	0.1869	5.35
85.	70.	316.0	287.0	1177.8	891.3	0.1980	5.05
90.	75.	320.2	291.2	1179.1	888.5	0.2089	4.79
91.	76.	320.8	292.0	1179.3	887.7	0.2111	4.74
92.	77.	321.7	292.8	1179.5	887.3	0.2133	4.69
93.	78.	322.2	293.6	1179.8	886.6	0.2155	4.64
94.	79.	323.2	294.4	1180.0	886.3	0.2176	4.60
95.	80.	324.0	295.1	1180.2	885.6	0.2198	4.55

LOSS IN FLUE GASES WITH AND WITHOUT ECONOMIZER

Herewith are 2 tables which have been calculated by the Green Fuel Economizer Co., the first showing the percentage of heat escaping in chimney gases at various flue temperatures, assuming 26 lb. of air used, and 14,500 B. t. u. per pound of coal and 15 per cent loss through grates and radiation.

The second table shows the minimum temperature to which it pays to cool the gases with boiler pressure 150 lb. gage, by means of boiler surface only, and by means of an economizer, taking the feed water at 3 different degrees of temperature. This table is based on an investment of $15 per nominal boiler horsepower in the boiler and $5 in stoker, grates and draft apparatus; interest at 5 per cent and sinking fund and maintenance charges 12 per cent. Cost of economizer is based on $1 per sq. ft., and annual charges for interest, depreciation, maintenance, power and current are 12 per cent.

TABLE 1.

PERCENTAGE OF HEAT ESCAPING IN CHIMNEY GASES

Chimney Temperature Deg. F.	B.T.U. in Gases Per Pound of Coal	Percentage of Total Heat in Gases	Ratio of Heat in Flue Gases above 60 deg. to heat absorbed by boiler.
200	905	6.25	8.
300	1555	10.7	14.4
400	2200	15.2	21.8
500	2850	19.68	30.2
600	3500	24.1	39.6
700	4150	28.6	50.6
800	4790	33.0	63.4
900	5440	37.5	79.0
1000	6090	42.0	97.5

HORSEPOWER FOR 1 LB. MEAN EFFECTIVE PRESSURE

Diam. Cyl. In.	Speed of Piston Ft. Per Min. 100	200	300	400	500	600	700	800	900
2	.0035	.0191	.0285	.0381	.0476	.0571	.0667	.0761	.0856
3	.0214	.0429	.0642	.0856	.1070	.1284	.1498	.1712	.1926
3½	.0292	.0583	.0874	.1166	.1457	.1748	.2040	.2332	.2621
4	.0381	.0762	.1142	.1523	.1904	.2285	.2667	.3048	.3429
4½	.0482	.0964	.1446	.1928	.2410	.2892	.3374	.3856	.4338
5	.0595	.1190	.1785	.2380	.2975	.3570	.4165	.4760	.5355
5½	0.072	0.144	0.216	0.288	0.360	0.432	0.504	0.576	0.648
6	0.086	0.171	0.256	0.342	0.428	0.513	0.600	0.685	0.771
7	.117	.233	.350	.467	.583	.700	.816	.933	1.050
7½	.134	.268	.402	.536	.669	.803	.937	1.071	1.205
8	.152	.305	.457	.609	.762	.914	1.066	1.219	1.371
9	.193	.386	.578	.771	.964	1.157	1.350	1.542	1.735
10	.238	.476	.714	.952	1.190	1.428	1.667	1.904	2.142
11	.288	.576	.864	1.152	1.440	1.728	2.016	2.304	2.582
12	.343	.685	1.028	1.371	1.714	2.056	2.399	2.742	3.085
13	.402	.804	1.207	1.609	2.011	2.413	2.816	3.218	3.620
14	.467	.933	1.399	1.866	2.332	2.799	3.265	3.732	4.198
15	.536	1.071	1.607	2.142	2.678	3.213	3.749	4.284	4.820
16	.609	1.219	1.828	2.437	3.046	3.656	4.265	4.874	5.484
17	.688	1.376	2.064	2.751	3.439	4.127	4.815	5.503	6.190
18	.771	1.542	2.313	3.085	3.856	4.627	5.398	6.169	6.940
19	.859	1.718	2.578	3.437	4.296	5.155	6.014	6.873	7.733
20	.952	1.904	2.856	3.808	4.760	5.712	6.664	7.616	8.568
21	1.050	2.099	3.149	4.198	5.248	6.298	7.347	8.397	9.446
22	1.152	2.304	3.456	4.608	5.760	6.912	8.063	9.215	10.37
24	1.371	2.742	4.113	5.484	6.854	8.225	9.596	10.97	12.34
26	1.609	3.218	4.827	6.436	8.044	9.653	11.26	12.87	14.48
28	1.866	3.732	5.598	7.464	9.330	11.20	13.06	14.93	16.79
30	2.142	4.284	6.426	8.568	10.71	42.85	14.99	17.14	19.28
32	2.437	4.874	7.311	9.749	12.19	14.62	17.06	14.50	21.93
34	2.751	5.503	8.254	11.01	13.76	16.51	19.26	22.01	24.76
36	3.085	6.169	9.253	12.34	15.42	18.51	21.59	24.68	27.76
38	3.437	6.873	10.31	13.75	17.18	20.62	24.06	27.49	30.93
40	3.808	7.616	11.42	15.23	19.04	22.85	26.66	30.46	34.27
42	4.198	8.387	12.59	16.78	20.98	25.18	29.38	33.58	37.78
44	4.608	9.215	13.82	18.43	23.04	27.65	32.25	36.86	41.47
45	5.036	10.07	15.11	20.14	25.18	30.22	35.25	40.29	45.33
48	5.481	10.97	16.45	21.93	27.42	32.90	38.39	43.87	49.35
50	5.950	11.90	17.85	23.80	29.75	35.70	41.65	47.60	53.55
52	6.436	12.87	19.31	25.74	32.18	38.61	45.05	51.48	57.92
54	6.940	13.88	20.82	27.76	34.70	41.64	48.58	55.52	62.46
55	7.464	14.93	22.39	29.86	37.32	44.78	52.25	59.71	67.17
58	8.005	16.01	24.02	32.03	40.03	48.04	56.04	64.05	72.05
60	8.558	17.14	25.70	34.27	42.84	51.41	59.98	68.54	77.11
62	9.149	18.30	27.44	36.60	45.75	54.90	64.04	73.19	82.34
64	9.748	19.50	29.24	38.99	48.74	58.49	68.24	77.99	87.74
66	10.37	20.73	31.10	41.47	51.84	62.20	72.57	82.94	93.31
68	11.00	22.01	33.02	44.02	55.02	66.03	77.03	88.04	99.05
70	11.67	23.33	34.98	46.65	58.31	70.13	81.63	93.29	105.0
72	12.34	24.68	37.01	49.36	61.69	74.02	86.37	98.70	111.0

CAPACITY OF BELT CONVEYORS IN TONS PER HOUR (CONTINUOUSLY AND UNIFORMLY LOADED)

Width of Belt, in.	Carrying Fine Coal at 400 f. p. m.	Carrying Lump Coal at 250 f. p. m.	Carrying Ash at 300 f. p. m.
12	40.0	100.8	27.5
14	54.0	119.5	36.5
16	71.3	135.8	48.2
18	90.7	158.3	61.2
20	111.3	179.3	75.2
22	148.7	200.8	91.4
24	161.3	228.3	109.0
26	191.3		129.2
28	217.0		146.7
30	253.0		171.0
32	286.5		193.5
34	321.3		217.0
36	365.3		246.6

TABLE 2. MINIMUM ECONOMICAL TEMPERATURE OF FLUE GASES FOR DIFFERENT PRICES OF COAL

Price of Coal	Cost of Boiler Horse Power Year	Boilers Alone: Critical Temperature Difference Between Steam and Gases, Deg. F.	Boilers Alone: Economical Temperature of Gases Leaving Boiler, Deg. F.	Economizer Plant: Critical Temperature Diff. Feed Water and Gases, Deg. F.	Economizer Plant: Temperature Flue Gases Leaving Economizer for Various Temperatures of Feed Water, Deg.		
					100 Deg.	150 Deg.	210 Deg.
FOR PLANT OPERATING 10 HR. A DAY 310 DAYS A YEAR.							
$2.00	$14.25	319	685	112.2	212.2	262.2	322.2
2.50	16.98	268	634	94.5	194.5	244.5	304.5
3.00	19.68	231	597	81.4	181.4	231.4	291.4
3.50	22.40	202	568	71.5	171.5	221.5	281.5
4.00	25.10	181	547	63.8	163.8	213.8	273.8
4.50	27.80	163	529	57.5	157.5	207.5	267.5
5.00	30.55	149	515	52.5	152.5	202.5	262.5
FOR PLANT OPERATING 24 HR. A DAY AND 365 DAYS A YEAR.							
$2.00	$34.10	133	499	47.0	147.0	197.0	257.0
2.50	41.75	109	475	38.3	138.3	188.3	248.3
3.00	49.40	92	458	32.4	132.4	182.4	242.4
3.50	57.10	80	446	28.0	128.0	178.0	238.0
4.00	64.70	70	436	24.7	124.7	174.7	234.7
4.50	72.40	63	429	22.1	122.1	172.1	232.1
5.00	80.00	57	423	20.0	120.0	170.0	230.0

NOTE—The best temperature for the gases leaving the economizer is affected to a certain extent by the conditions in the plant under consideration.

PROPERTIES OF SATURATED STEAM

Pressure lb. per sq. in. Absolute	Pressure lb. per sq. in. Gage	Temperature Deg. F	Heat from 32 deg. F., B. t. u. In Liquid	Heat from 32 deg. F., B. t. u. Total in Steam	Latent Heat of Vaporization B. t. u.	Weight lb. per cu. ft. of Steam	Vol. cu. ft. per lb. Steam
96	81	324.8	295.9	1180.5	885.2	0.2219	4.51
97	82	325.5	296.7	1180.7	884.6	0.2241	4.46
98	83	326.3	297.4	1180.9	884.1	0.2263	4.42
99	84	326.9	298.2	1181.1	883.5	0.2285	4.38
100	85	327.9	298.9	1181.4	883.1	0.2307	4.33
101	86	328.4	299.7	1181.7	882.5	0.2329	4.30
102	87	329.1	300.4	1181.9	882.0	0.2351	4.26
103	88	329.8	301.1	1182.1	881.5	0.2373	4.22
104	89	330.3	301.9	1182.3	881.0	0.2393	4.20
105	90	331.3	302.6	1182.5	880.7	0.2414	4.14
106	91	331.9	303.3	1182.7	880.1	0.2435	4.10
107	92	332.6	304.0	1183.0	879.6	0.2456	4.07
108	93	333.3	304.7	1183.2	879.1	0.2777	4.03
109	94	334.0	305.4	1183.4	878.6	0.2499	4.00
110	95	334.6	306.1	1183.6	878.3	0.2521	3.97
111	96	335.3	306.8	1183.8	877.8	0.2543	3.94
112	97	336.0	307.5	1184.0	877.3	0.2564	3.91
113	98	336.6	308.2	1184.2	876.8	0.2586	3.87
114	99	337.3	308.8	1184.4	876.3	0.2607	3.84
115	100	338.0	309.9	1184.5	875.9	0.2628	3.80
116	101	338.6	310.2	1184.7	875.4	0.2649	3.78
117	102	339.2	310.8	1184.9	874.9	0.2652	3.75
118	103	339.8	311.5	1185.1	874.5	0.2674	3.72
119	104	340.5	312.1	1185.3	874.1	0.2696	3.69
120	105	341.1	312.8	1185.4	873.7	0.2738	3.65
121	106	341.7	313.4	1185.6	873.2	0.2759	3.63
122	107	342.3	314.1	1185.8	872.8	0.2780	3.61
123	108	342.9	314.7	1186.0	872.3	0.2801	3.58
124	109	343.5	315.3	1186.2	871.9	0.2822	3.55
125	110	344.2	316.0	1186.4	871.5	0.2345	3.51
126	111	344.8	316.6	1186.6	871.0	0.2367	3.49
127	112	345.4	317.2	1186.8	870.6	0.2889	3.46
128	113	345.9	317.8	1187.0	870.2	0.2911	3.44
129	114	346.6	318.4	1187.1	869.8	0.2933	3.41
130	115	347.2	319.1	1187.3	869.4	0.2955	3.38
131	116	347.7	319.7	1187.5	868.9	0.2977	3.36
132	117	348.3	320.3	1187.7	868.5	0.2999	3.34
133	118	348.9	320.8	1187.9	868.0	0.3020	3.31
134	119	349.5	321.5	1188.0	867.7	0.3040	3.29
135	120	350.1	322.1	1188.2	867.4	0.3060	3.27
136	121	350.6	322.6	1188.4	867.0	0.3080	3.25
137	122	351.2	323.2	1188.6	866.6	0.3101	3.23
138	123	351.9	323.8	1188.7	866.2	0.3121	3.20
139	124	352.3	324.4	1188.9	865.8	0.3142	3.18
140	125	352.9	325.0	1189.0	865.4	0.3162	3.16

OPERATING COST OF BELT CONVEYORS

HORIZONTAL CONVEYOR

Length of Conveyor, Ft.	Total Cost, Dollars.
25	0.005475WC+0.00085312W
50	0.010950WC+0.00164462W
100	0.021900WC+0.00322762W
250	0.054750WC+0.00797662W
500	0.109500WC+0.01589162W

INCLINED CONVEYOR

Add 0.00101WC+0.00001W for each foot of raise in length of conveyor.

Where:—
W = Weight of load conveyed in tons per hour.
C = Cost of one horsepower per hour.

OPERATING COST PER TON CONVEYED BY BELT CONVEYORS

HORIZONTAL CONVEYORS

Distance Conveyed, Ft.	Cost Dollars
25	$0.00096262
50	0.00186362
100	0.00366562
250	0.00907162
500	0.01808162

INCLINED CONVEYORS

Add $0.0000302 to the cost of handling per ton for each foot of rise in length of conveyor.

Material:—Coal or Ash. Cost of 1 hp. hr. = $0.02.

PISTON SPEEDS IN FEET PER MINUTE

Revolutions Per Minute.	50	60	70	80	90	100	120	125	140	150	160	170	180	200	215	225	230	250	275	290	300	320	325	340	350	375	400
	42	50	58	67	75	84	100	104	117	125	133	142	150	167	179	188	192	208	229	242	250	267	271	283	292	313	334
	50	60	70	80	90	100	120	125	140	150	160	170	180	200	215	225	230	250	275	290	300	320	325	340	350	375	400
	58	70	82	93	105	117	140	146	163	175	187	198	210	233	251	262	269	292	321	339	350	374	379	396	408	438	467
	67	80	93	107	120	133	160	167	187	200	213	227	240	267	287	300	307	333	367	387	400	427	433	453	467	500	533
	75	90	105	120	135	150	180	188	210	225	240	255	270	300	323	337	345	375	412	435	450	480	487	510	525	563	600
	83	100	117	133	150	167	200	208	233	250	267	283	300	333	358	375	384	417	458	483	500	533	542	567	583	625	667
	92	110	128	147	165	183	220	229	257	275	293	312	330	367	394	412	422	458	504	532	550	587	596	624	642	688	733
	100	120	140	160	180	200	240	250	280	300	320	340	360	400	430	450	461	500	550	580	600	640	650	680	700	750	800
	108	130	152	174	195	217	260	271	304	325	347	369	390	433	466	488	499	542	596	630	650	693	704	737	758	813	867
	117	140	163	187	210	233	280	292	327	350	373	397	420	467	502	525	537	583	642	677	700	747	758	793	817	875	933
	125	150	175	200	225	250	300	313	350	375	400	425	450	500	538	562	576	625	687	725	750	800	812	850	875	937	1000
	133	160	187	213	240	267	320	333	373	400	427	453	480	533	573	600	613	667	733	774	800	853	867	907	933	1000	1067
	150	180	210	240	270	300	360	375	420	450	480	510	540	600	645	675	690	750	825	870	900	960	975	1020	1050	1125	1200
	167	200	233	267	300	334	400	417	467	500	533	567	600	667	717	750	767	833	917	967	1000	1067	1083	1133	1167	1250	1333
	175	210	245	280	315	350	420	438	490	525	560	595	630	700	753	788	806	875	963	1014	1050	1120	1138	1190	1225	1313	1400
	183	220	257	293	330	367	440	458	513	550	587	623	660	733	789	825	843	917	1008	1063	1100	1173	1192	1247	1283	1375	1467
	200	240	280	320	360	400	480	500	560	600	640	680	720	800	860	900	920	1000	1100	1160	1200	1280	1300	1360	1400	1500	1600
	217	260	303	347	390	433	520	542	607	650	693	737	780	867	932	975	997	1083	1192	1257	1300	1387	1408	1473	1517	1625	1731
	225	270	315	360	405	450	540	563	630	675	720	765	810	900	968	1013	1035	1125	1238	1305	1350	1440	1463	1530	1575	1688	1800
	233	280	327	373	420	467	560	583	653	700	747	793	840	933	1004	1050	1073	1167	1283	1353	1400	1493	1517	1587	1633	1750	1867
	242	290	339	387	435	483	580	604	677	725	773	822	870	967	1039	1088	1112	1208	1329	1402	1450	1547	1571	1644	1692	1813	1933
	250	300	350	400	450	500	600	625	700	750	800	850	900	1000	1075	1125	1150	1250	1375	1450	1500	1600	1625	1700	1750	1875	2000
	258	310	362	413	465	517	620	646	724	775	827	879	930	1033	1110	1163	1189	1292	1421	1498	1550	1653	1679	1756	1808	1938	2067
	267	320	373	427	480	533	640	667	747	800	853	907	960	1067	1146	1200	1227	1333	1467	1547	1600	1707	1733	1813	1867	2000	2133
	275	330	385	440	495	550	660	688	770	825	880	935	990	1100	1183	1238	1265	1375	1513	1595	1650	1760	1788	1870	1925	2063	2200
	283	340	397	453	510	567	680	708	793	850	907	963	1020	1133	1219	1275	1304	1417	1558	1644	1700	1813	1842	1927	1983	2125	2267
	292	350	408	467	525	583	700	729	817	875	933	992	1050	1167	1256	1313	1342	1458	1604	1693	1750	1867	1896	1983	2042	2188	2333
	300	360	420	480	540	600	720	750	840	900	960	1020	1080	1200	1292	1350	1380	1500	1650	1740	1800	1920	1950	2040	2100	2250	2400
	313	375	438	500	563	625	750	781	875	937	1000	1063	1125	1250	1346	1406	1438	1563	1719	1813	1875	2000	2031	2125	2188	2344	2500
	317	380	443	507	570	633	760	792	887	950	1013	1077	1140	1267	1364	1425	1457	1583	1742	1838	1900	2027	2058	2153	2217	2375	2533
	325	390	455	520	585	650	780	813	910	975	1040	1105	1170	1300	1400	1463	1495	1625	1788	1886	1950	2080	2113	2210	2275	2438	2600
	333	400	467	533	600	667	800	833	933	1000	1067	1133	1200	1333	1436	1500	1533	1667	1833	1933	2000	2133	2167	2267	2333	2500	2667
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	358	430	502	573	645	717	860	896	1003	1075	1147	1219	1290	1433	1544	1613	1648	1792	1971	2078	2150	2293	2329	2436	2508	2688	2867
	367	440	513	587	660	733	880	917	1027	1100	1173	1247	1320	1467	1581	1650	1686	1833	2017	2126	2200	2347	2383	2493	2567	2750	2933
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	383	460	537	613	690	767	920	958	1073	1150	1227	1303	1380	1533	1653	1725	1762	1917	2108	2223	2300	2453	2492	2607	2683	2875	3067
	392	470	548	627	705	783	940	979	1097	1175	1253	1332	1410	1567	1689	1763	1800	1958	2154	2272	2350	2507	2546	2664	2742	2938	3133
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	408	490	572	653	735	817	980	1021	1143	1225	1307	1388	1470	1633	1761	1838	1878	2042	2246	2369	2450	2613	2654	2777	2858	3063	3267
	417	500	583	667	750	833	1000	1042	1167	1250	1333	1417	1500	1667	1797	1875	1917	2083	2292	2417	2500	2667	2708	2833	2917	3125	3333
	425	510	595	680	765	850	1020	1063	1190	1275	1360	1445	1530	1700	1833	1913	1955	2125	2338	2465	2550	2720	2763	2890	2975	3188	3400
	433	520	607	693	780	867	1040	1083	1213	1300	1387	1473	1560	1733	1869	1950	1993	2167	2383	2513	2600	2773	2817	2947	3033	3250	3467
	442	530	618	707	795	883	1060	1104	1237	1325	1413	1502	1590	1767	1906	1988	2032	2208	2429	2562	2650	2827	2871	3004	3092	3313	3533
	450	540	630	720	810	900	1080	1125	1260	1350	1440	1530	1620	1800	1942	2025	2070	2250	2475	2610	2700	2880	2925	3060	3150	3375	3600
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	492	590	688	787	885	983	1180	1229	1376	1475	1573	1672	1770	1967	2122	2213	2260	2458	2704	2853	2950	3147	3196	3343	3442	3688	3933
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	583	700	817	933	1050	1167	1400	1458	1633	1750	1867	1983	2100	2333	2518	2625	2678	2917	3208	3383	3500	3733	3792	3967	4083	4375	4667
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Common practice seldom allows over 600 ft. piston speed.

THE BOILER SCALE PROBLEM SOLVED

Every up-to-date engineer is on the look-out for a safe and efficient means for the removal of boiler scale and the prevention of its re-formation. Chiselling from boiler interiors wastes valuable time and does not reach inaccessible parts; and any "compound" in order to destroy or neutralize the scale-making properties of feed waters is necessarily so chemically-powerful that it eats into and pits the plates.

An agency which overcomes boiler scale without the needless use of tools or the employment of expensive and dangerous compounds has been discovered in U. S. GRAPHITE CO.'S MEXICAN BOILER GRAPHITE.

Exhaustive tests extending over a period of years and conducted under the most exacting conditions prove that U. S. GRAPHITE CO.'S MEXICAN BOILER GRAPHITE introduced into the feed water of a boiler will disintegrate and break up old scale so that it may be easily removed; also that, by circulating in the water with the impurities that would otherwise form hard scale, it renders the formation so soft as to make the scale—if scale does form—easy to remove.

U. S. GRAPHITE CO.'S MEXICAN BOILER GRAPHITE contains no acids or alkalis—its action is purely mechanical, not chemical—it cannot cause foaming or priming—being insoluble, it can not pass out of the boiler with the steam and thereby render it unfit for certain industrial purposes—and it cannot possibly injure the boiler in the slightest degree.

We guarantee that U. S. GRAPHITE CO.'S MEXICAN BOILER GRAPHITE, used in accordance with our directions, will clean your boilers of scale and then make them easy to keep clean at about one-third the cost of any other method known.

Write for our Booklet, "THE MANAGEMENT AND CLEANING OF STEAM BOILERS," which goes into detail regarding the workings of this efficient cure for the boiler scale evil—besides also containing a great deal of other helpful information which the practical man will appreciate. Drop us a card—TODAY.

Put up in 100 lb. Kegs and Barrels (about 350 lbs.) Write for Quotations.

The United States Graphite Co.

Miners of Graphite and Manufacturers of Graphite Products

Saginaw U. S. A. Michigan

539 Styles of Detroit Lubricators

Because no **one** lubricator can be made to give proper service under **all** conditions, you will find in the Detroit line a lubricator for every condition.

You will find a Detroit Lubricator exactly suited to your requirements. Every Detroit Lubricator is the product of scientific study of the service for which it is designed.

And 1,250,000 Detroit Lubricators are proving every day that each one is the right one for its particular place.

The Detroit Lubricator is the world's standard of excellence.

Over two-thirds of the lubricators in the world are Detroits and wherever a Detroit Lubricator has been used, the name "Detroit" has come to mean **quality.**

Every Detroit Lubricator embodies all the refinements made possible by long experience in the selling and manufacture of sight feed lubricators and by careful study of the many lubricators in the hands of customers using them on all kinds of engines all over the world.

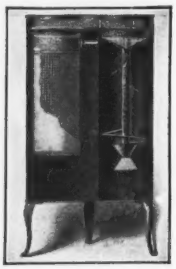
DETROIT LUBRICATOR COMPANY.

DETROIT, U. S. A.

Largest manufacturers of lubricating devices in the world.

SAVES 75%

OVER 5,000 IN SERVICE



White Star Oil Filters and Oiling Systems are in service in over 5000 power plants and machinery of more than 2,000,000 horsepower is being lubricated by them. There are reasons for this:

1st. They save oil. You are enabled to refine, purify and use the oil that would otherwise go to waste. Not a drop is lost.

2nd. They save machinery. You can give the bearings an ample supply of good, pure lubricating oil, thereby reducing friction, eliminating wear and tear, avoiding hot bearings and substantially reducing repairs.

3rd. They save labor. You are not required to oil by hand. Each bearing is automatically lubricated by the gravity system of feed, and the supply is continuous and sure.

*** * * "In regard to the 'White Star' Oil Filter purchased of you, would say that our Superintendent advises us that the filter is giving entire satisfaction and saves us about 75 per cent of the oil used." (Utica Industrial Co., Rome, N. Y.)**

The above speaks for itself. Hundreds of pleased and satisfied customers have told us the same thing. As a matter of economy, it will pay you to investigate the merits of the White Star Oil Filter and Continuous Oiling System. We offer you a White Star Filter on thirty days' trial and if it is not satisfactory you may return it at our expense. In many instances, we have been able to effect savings of 85 per cent. We guarantee 50 per cent reduction in your oil account.

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THIS BOOK FREE TO YOU

This Book is devoted to the problem of Lubrication. It illustrates various methods of installing Continuous Oiling Systems, arrangement of Piping, etc., gives information on Mechanical Efficiency and Oil Economy. In fact, it is a **"Treatise on Lubrication."** Sent free if you will sign and return the coupon below.

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Dept. "B," Pittsburgh, Pa.

Gentlemen: I am interested in Oil Economy and you may send to me, postpaid, a copy of your **"Treatise on Lubrication."** You may also send me booklets describing the articles marked X.

Steam Separator	Dust Collecting System
Exhaust Head	Self-Closing Water Gage
Recording Gage	Take-Down Gage Cock
Blow-off Valve	High Pressure Piping
Water Columns	Pipe Bends
Globe Valves	
Gate Valves	
Ventilators	

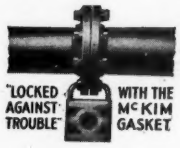
Name .....

Position .....

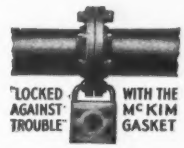
Firm's Name .....

St. and No. .....

City .....State .....



"McKIM" GASKETS



MAKE TIGHT JOINTS
KEEP JOINTS TIGHT

One day a locomotive engineer got mad—he got mad clear through because his pipe joints wouldn't stay tight. He had a mighty important run to make, and well, you know what that means.

How to protect that packing from the heat and the pressure until he had finished his run! He was at his wit's end, so he thought. In reality they were just beginning to work. He looked around; saw some soft copper lying in his tool chest; snatched it up and bending it into a crude sort of a shell, encased his packing in it.

Imagine his satisfaction when this simple, original device proved successful and the packing lasted not only for that run but for every run for many a month.

Our famous "McKIM" is a development of that engineer's idea and this perfected gasket is guaranteed to give the engineer of today satisfaction—the permanent, enduring kind.

Send for a sample "McKIM." Examine it. Note the soft copper shell, the quality of the packing. Give it a good stiff trial. You'll be glad that engineer got mad eighteen years ago.

MAIL THIS COUPON FOR FREE GASKET

To McCord Manufacturing Company, Detroit, Mich.

Please send me Free, a McKim Gasket .....

Service for which it is intended .....

Size of Pipe .....

Name .....

Address .....

A G

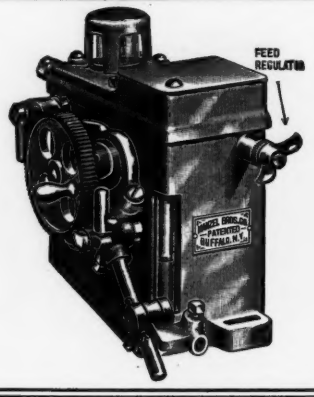
McCORD MANUFACTURING CO.

New York DETROIT, MICHIGAN Chicago

AGENCIES:

Boston Pittsburgh Richmond St. Louis San Francisco Seattle Denver St. Paul

Ever Have Trouble, in Cold Weather, Oiling Your Engine Cylinders?



You will never have any trouble lubricating your engine cylinders in cold weather if you use a Manzel Class "HA" Oil Pump—for it's guaranteed to work as well in zero weather as in summer.

Manzel Pumps are designed especially for cold weather use and are not effected by the temperature.

Thick or thin oil is all the same to Manzel Pumps.

Thousands of them are in daily use on engines which are exposed to all kinds of weather; and they are giving excellent satisfaction.

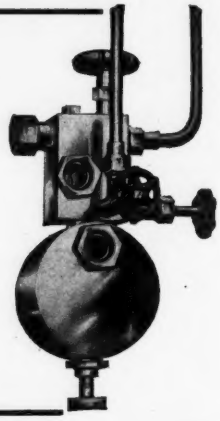
They are Oil Savers, Labor Savers and Engine Savers—and will pay for themselves in a few months' use.

Let us send you one on thirty days' free trial, or write for Catalogue No. 15.

Manzel Brothers Company

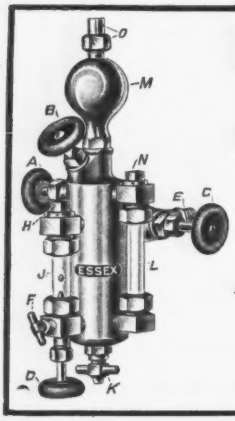
327 Babcock Street **Buffalo, N. Y.**

OHIO CYLINDER GREASE



has proven its superiority over every known lubricant in several thousand plants, and hundreds of new ones are beginning its use every month. Every drop is atomized before reaching the steam line by automatic lubricators that are furnished and kept in repair absolutely free. These lubricators are thoroughly covered by patents which make it illegal to make use or vend any infringement or imitation of them or any of their parts.

The Ohio Grease Lubricant Co., Box 434, Loudonville, Ohio



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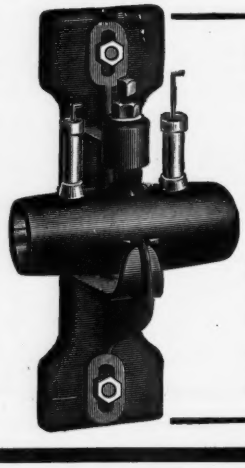
are not the best, —but

There are NO BETTER made.

Our GUARANTEE is as good as anybody's GUARANTEE

All our Goods are Sold and GUARANTEED by us.

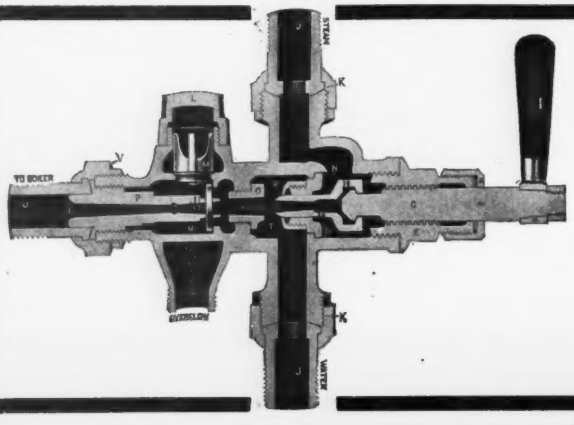
G. B. ESSEX BRASS CO.
DETROIT, MICH.



Why Not

use SWAIN'S lubricants. They are effective, work when and where you need lubrication; are positive, and save wear and friction. You save enough by increased power and lack of wear on bearings to pay for your lubrication. Try it now. We have experts on lubrication and will gladly answer all inquiries.

SWAIN LUBRICATOR CO.
328 West Lake Street, CHICAGO



For 23 Years
The
"Buffalo Automatic" Injector
Has Maintained
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GUARANTEED.

Re-Starting---Simple Construction---High Lift---Wide Working Range.

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SHERWOOD MANUFACTURING CO.,
Write Dept. 'E' **BUFFALO, N. Y.** *for Catalogue*

The
Bowser Oil Filtration and Circulating System

If results are what you want the Bowser System is what you must have because it has so many essential features that are exclusive with it.

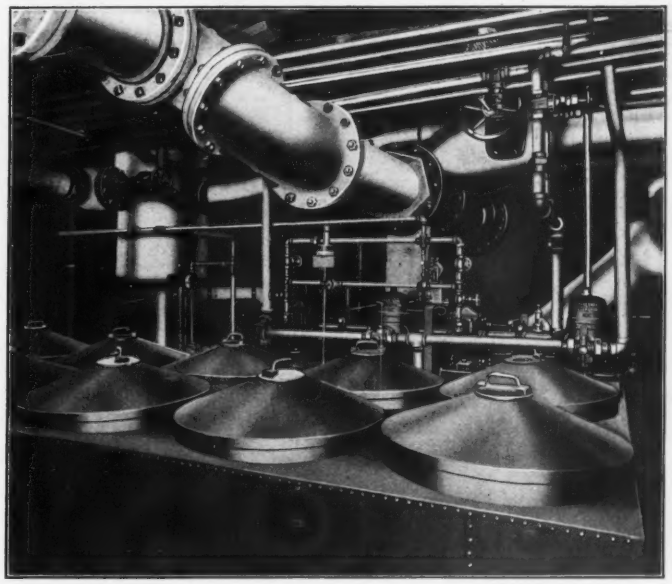
We furnish 3 sq. ft. of filtering surface for each gallon of oil per hour to be filtered.

The Bowser has an available pressure head of 3 ft. which can be exerted over the entire filter surface whether the drip tank be full or empty.

These systems are of such capacity and so equipped they can supply oil ten to fifteen hours without operating filters or pumps. (Our book explains all the advantages).

Our engineers are ready to furnish expert advice on the requirements for your power department and there is no charge or obligation connected with this service.

Write For Our Oiling System Book No 5Z.



This illustration was made from a photograph of the Bowser Oil Filtration and Circulating System installed for the Curtis Publishing Company, Philadelphia. This cut does not show the Separator and Refuse Oil tanks which were a part of this installation.
This system is connected to one simple and six cross-compound engines, two ammonia compressors, several pumps and other machinery and amply meets these enormous demands.

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DIXON'S
BELT DRESSING

Slipping of belts wastes power and burns the Belt. Dixon's Belt Dressing stops slipping and thus makes more power available, and preserves the belt. Sample 96-O FREE.

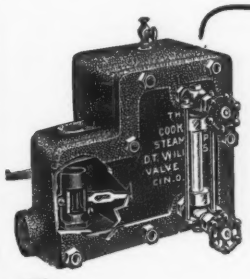
JOSEPH DIXON CRUCIBLE CO.
JERSEY, CITY, N. J.

Trade Mark Reg. U.S. Pat. Office
"Bound Brook"
Serial, 55,909
Graphite and Bronze Bearings

They Mean
Cleanliness, Satisfaction and Economy
Send for our Booklet

Graphite Lubricating Co.,
East Main Street, - Bound Brook, N. J.

A Record of over 20 years of Satisfied Customers.
The "BOUND BROOK" is the Genuine.



Judge a Trap by its Simplicity

The steam trap question is an important one for the engineer or steam fitter and should be carefully considered. It is a well known fact that a trap that is complicated in construction is more liable to get out of order and give more trouble than one which has the advantages of simple construction. Simplicity means reliability and durability. They are the elements which make a successful steam trap.

The Cookson Low Pressure Trap

is simplicity itself. Of few working parts, the valve is of the single seated type—is perfectly balanced, and is very sensitive to large slugs of water, which it readily discharges without any loss of steam. Perfectly automatic in its action, it has no equal for draining Exhaust Lines, Fan Coils or Heating or any other Systems working on 30 pounds pressure or less. If you want *steam trap satisfaction*—you need a Cookson trap.

Catalog mailed on receipt of postal

THE D. T. WILLIAMS VALVE CO.

Spring Grove Ave. and Township St. CINCINNATI, OHIO

12

You Have An Assured Amount Of Lubricant In Your Oil Can When You Use

Capitol Cylinder Oil

The use of ***Capitol Cylinder Oil*** means that your engine is getting ***all-lubricant*** in every drop. It reduces friction to its lowest point and accordingly prolongs the life of the engine.

And, besides, ***Capitol Cylinder Oil*** lasts much longer than a cheap cylinder oil. Its high quality has made it widely and favorably known throughout the Uuited States and Canada.

Renown Engine Oil

This is an oil light in body and in color. It is an especially good oil for the lubrication of rapidly running bearings. It can be filtered time and again without losing any of its valuable lubricating qualities.

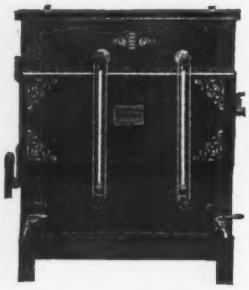
Both ***Capitol Cylinder Oil*** and ***Renown Engine Oil*** are sold in barrels and half-barrels.

Standard Oil Company
(Incorporated)

Copious Lubrication

The flooding or splash system is recognized as a satisfactory method of oiling. So is the drop by drop system; each has its advantages for certain classes of machinery—each consumes oil.

The conditions in your plant may require one or both of these methods, yet neither is economical unless you are filtering the oil and no other filtration process has the advantages found in the



Franklin System

Franklin Oil Filters increase the efficiency of either method by reclaiming over 70 per cent of the oil you use, whether the volume be 5 or 1000 gallons a day.

Dirt, grit and all foreign substances are entirely removed and the viscosity and lubricating quality of the oil is fully restored.

We want to demonstrate and prove our claims in your plant, without putting you to any expense or trouble. Any time you are ready, say so.

Franklin Oil Filter Co.
6 North Main Street St. Louis, Mo.

The Insurance Companies Also Recommend Individual Oiling Systems

We are now ready to prove that **Richardson-Phenix Individual Oiling and Filtering Systems** reduce oil bills and the cost of maintenance by 25 to 75 per cent.

Now here is another advantage of the automatic oiling system that should not be overlooked. One of the largest insurance companies recommends the following:

"Engines should be provided at all necessary points, with automatic lubricating devices, and the attendant thus relieved of the dangerous work of lubricating the various parts one by one."

Often lubricating points are in out of the way places and difficult of access, but these systems insure that none of the bearings will be neglected because they are "unget-at-able" or dangerous of access.

We can at an interesting price supply you with a **Richardson-Phenix Oiling System,** including everything necessary for lubricating any steam engine, gas engine, air compressor, vacuum pump or any auxiliary engine, if you will just state the size and type of the machine.

In order to bring your lubrication Information up to date write to-day for

Book P-53 on Cylinder Lubrication for Main units.

Book P-54 on Cylinder Lubrication for High speed engines and auxiliaries.

Book P-55 on Automatic Bearing Lubrication.

THE RICHARDSON-PHENIX CO.
LARGEST EXCLUSIVE MANUFACTURERS OF OILING DEVICES
Works: Milwaukee, Wis.
Sales Offices.
New York, Philadelphia, Pittsburg, Chicago, Washington

39

TRADE MARK REGISTERED IN
NON-FLUID OIL
UNITED STATES PATENT OFFICE

Assures Continuously Cool Bearings—No Power Waste

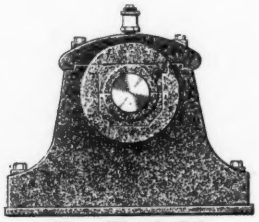
Any lubricant which requires friction in the bearings to make it feed is a source of waste.

It wastes power, wastes coal, reduces the efficiency of the machine.

Cleanliness may be important, lubricant economy may be a big feature, but —

After all, the point which determines the value of a lubricant is its friction-reducing quality.

And for that, pure mineral oil cannot be excelled.



Non-Fluid Oil For Main Bearings

Non-Fluid Oil is made in various densities to suit different requirements.

For main bearings the K No. 000 density may be used. It is fed through Philadelphia Grease Cups and feeds into the bearings as they need it—no more or less—every drop is full of lubricating value—not a drop is wasted.

Where Non-Fluid Oil is to be used instead of fluid oil the A No. 00 grade should be used. Goes five times as far when used in oil can.

In Non-Fluid Oil you secure pure mineral oil put up in wasteless, dripless from.

It keeps the bearings continually cool; it does not require frictional heat to make it feed.

In fact it does everything that pure mineral oil does as far as friction reducing is concerned—

But it does not drip, does not flow out of the bearings, does not dirty the floors and machinery. You need no drip pans or splash boards when you use Non-Fluid Oil; every drop is used to good advantage.

Try Non-Fluid Oil—fill out the coupon and we'll send you a liberal sample Free. But mail the coupon today.

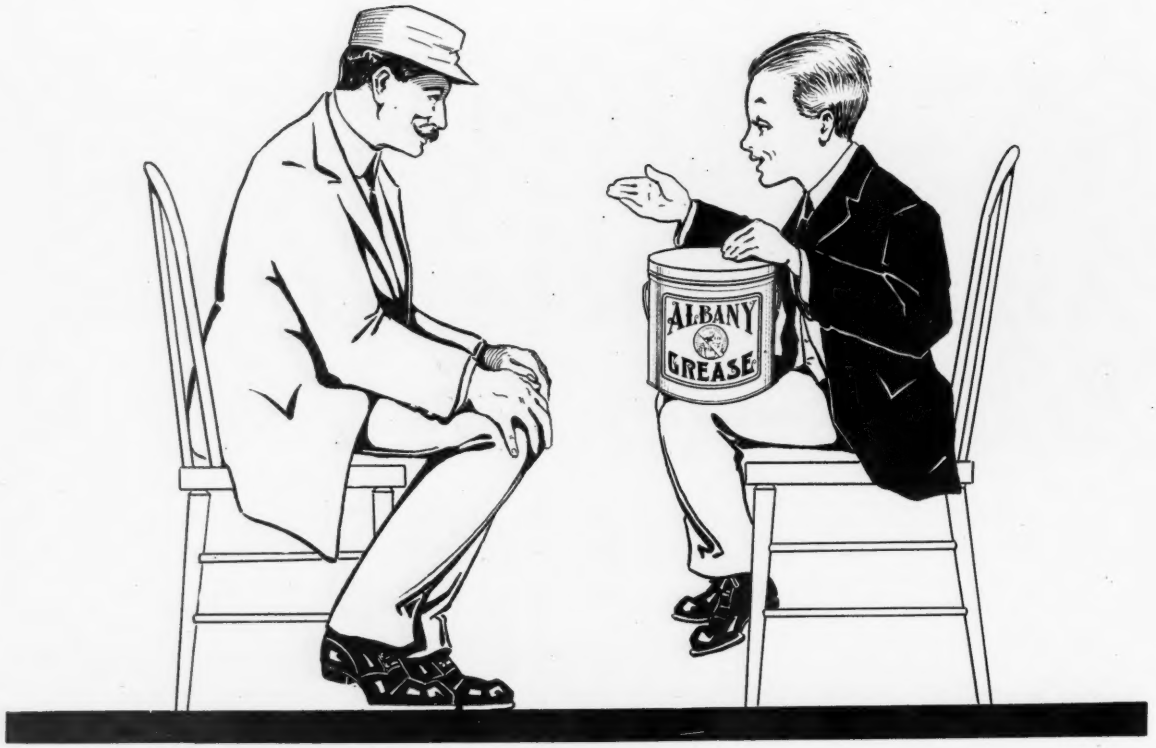
P.E.

Please send me, absolutely free, sample of Non-Fluid Oil and Booklet "The Survival of the Fittest."

Name .....
Address .....
.....
Firm's Name.....
How applied.....
Where Sample Will Be Used.....
.....
Type of Bearing.....
Size and Speed of Journal.....

New York and New Jersey Lubricant Company

165 Broadway New York City



The Harder the Job the More You'll Appreciate

"ALBANY GREASE"

"The severest test to which you can put any lubricant is to use it where the surface to be lubricated is large and exposed to the air—as is the case on the Engine Slides.

"And this is just the class of work in which the superiorities of Albany Grease stand out most conspicuously.

"For it enables you to see just how a small quantity of Albany Grease does the work done by a large quantity of any other lubricant; that "Albany" will not dry out; that it is wasteless, economical—the *most* economical of all lubricants.

"Albany Grease is good for all moving parts of machinery and an excellent protection to the surfaces of machinery when coated with it during shipment, erection or closing down of plant. It can readily be removed without scraping the surface and will retain the brightness of surface during the period that machinery is covered with it."

THE ALBANY GREASE BOY

A liberal sample of Albany Grease, an Albany GreaseCup and a valuable book, "Economic Lubrication," will be sent free of charge to ***Make Good*** *our claims, on receipt of your name and address.*

Albany Lubricating Company

ADAM COOK'S SONS, *PROPRIETORS*

708-710 Washington St., New York, U. S. A.

ONE EDGE GREEN

And This TRADE MARK On Every Roll of

GANDY Belting

These Two Identifying Marks Are Put There to Save You Money

The many sad experiences we learn of every day where belt users are duped into buying one of the numerous inferior cheap imitations of **THE GANDY BELT (red stitched cotton duck)** make us more anxious to caution you to **"look for the Belt with the Green Edge"** and the **Trade-Mark shown above,** every few feet of its length.

Remember, **THE GANDY BELT** is backed by 34 years of success and not only is the most durable and satisfactory belting for driving, elevating and conveying, but **costs only one-third as much as leather** and is **25 per cent cheaper than rubber,** yet will do the work equally as well.

We want to send you actual sample of **THE GANDY BELT,** and additional proof of the **big saving** this belting would be to you.

Drop us a postal to-day.

THE GANDY BELTING COMPANY

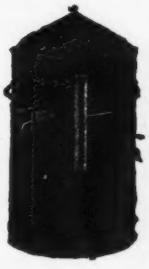
754 West Pratt Street **Baltimore, Md.**

New York Office: 88-90 Reade Street

60 Days' Time

in which to test the earning capacity of an

Acme Oil Filter



You know how much oil your machinery takes every month and exactly what it costs. We know an ACME FILTER will save a whole lot over your present expense. How much depends on the quantity of oil you use—but it will be enough to soon pay for the filter and show a big monthly saving over your present oil consumption.

We are so positive on this point that we will send you a filter free on SIXTY DAYS' TRIAL with the understanding that it must prove its worth.

The only trouble you are put to is the filling out and mailing of the coupon:

COUPON

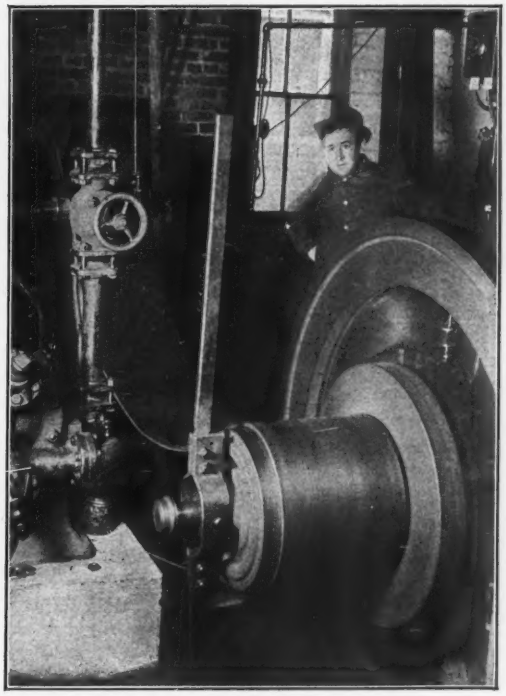
Walter L. Flower Co., 313 South 8th St., St. Louis, Mo.

Gentlemen: Please send me your 60-day free trial proposition on the Acme Oil Filter. We use about ..... gallons of lubricating oil per month.

Firm Name.....

City .....**State** .....

Signed by.....



Some Figures on the Saving From Cling-Surface

For example, take a power plant with engine delivering 100 brake horse power where the belt slips slightly—so little that you think it "isn't worth bothering about." Every one percent of slip on that belt means one horse power lost throughout the year.

Sames' Mechanical Engineers' Pocket Book, (p. 127) places the cost of power with large compound condensing engines at from 0.8 to 1.0 cent per h. p. hour. If we suppose, in the above plant, that power costs 0.9 cent which would be low for a 100 h. p. engine, the cost of each percent of slip on the engine belt per year if the plant operated continually would therefore be $.009 × 24 × 365 = $78.84.

This is by no means an exaggeration, but a common loss of which the operator is often unaware, and which summed up for all the slipping belts in a plant can make an astounding figure. Yet Cling-Surface treatment will stop all the slip and its consequent expense at a cost not exceeding a wee small percent of the saving it effects, and will at the same time keep all belts in prime condition and waterproofed throughout the longest possible life.

Saturation of belts with Cling-Surface will not only save this lost power and save the belts, but will make possible running the belts easy or slack and thus remove from pulleys, shafting and bearings those useless strains that eat up lubricants and power and coal and the repair man's time.

Timely and consistent Cling-Surface treatment of any leather, cotton, balata, or rubber belts or transmission ropes invariably saves big money.

Our literature explains this and our liberal offer on a trial order.

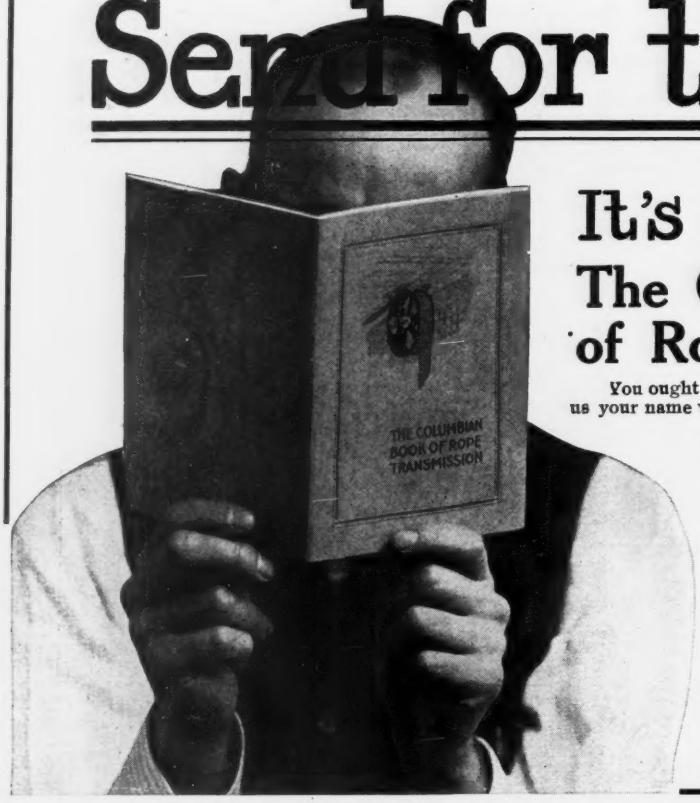
Cling-Surface Co

1028 Niagara Street **Buffalo N Y**

New York Boston Chicago Denver Atlanta Memphis Etc

38

Send for this Book



It's Free

The Columbian Book of Rope Transmission

You ought to have this book in *your* hands today. If you'll send us your name we'll send the book by return mail.

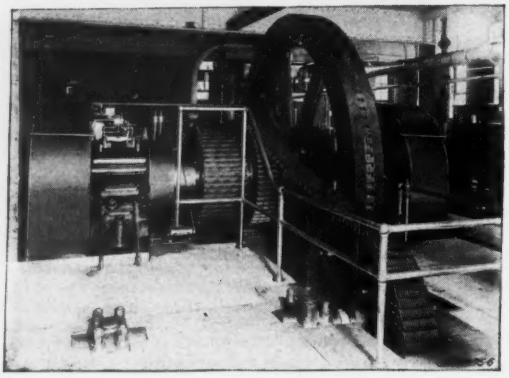
It contains valuable information about rope drives and Transmission rope. It will help you in your power problems.

Just look at a few of the chapter headings. They give but an *idea* of what the book has in store for you.

1. The Rope Drive. (Both systems illustrated and described.)
2. Advantages of Rope Drives.
3. Practical Points for Man in Charge.
4. How to Order Transmission Rope.

If you have a rope drive in your plant, or are thinking of putting one in, this book will be invaluable. Send for it now.

Columbian Rope Co.
817-859 Genesee St. Auburn, N. Y.



1000 and 500 H. P. Morse Silent Chains Driving Line Shafts.

For covenience of application, for compactness, for quiet action under high speeds, and for efficiency, use

The Morse Rocker Joint Chain

You may recognize its value for power transmission up of 100 H. P. without realizing or knowing the advantages to its application to larger units and main shaft drives. These figures on the installation illustrated may interest you:

1000 H. P.—95 to 70 R. P. M. on 103.24 inch centers. Sprockets. 61 to 83 teeth. Chain, 3 inch pitch, 24 inches wide. Speed, 1450 feet per minute.
500 H. P.—95 to 75 R. P. M. on 135.32 inch centers. Sprockets. 61 to 77 teeth. Chain, 3 inch pitch, 12 inches wide. Speed, 1450 feet per minute.

[See our Catalogue No. 9 for Complete Information

MORSE CHAIN CO., Ithaca, N. Y.

There is nothing like the Original Steel Pulley for Efficiency and Ultimate Economy
Insist on having

THE AMERICAN.

Patented

You will have the BEST, and in the long run the CHEAPEST. No Key-ways, no Set-screws, No Slip.

Sold by dealers everywhere.
Catalogue gives particulars.

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Office and Works: Philadelphia, Pa.
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BULLETIN 108 PE.—Mechanical Draft.
BULLETIN 113 PE.—Green Economizers at the Manhattan Power Station.
CATALOGUE 127 PE.—Green Steel Plate Fans.
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THE GREEN FUEL ECONOMIZER CO.
MATTEAWAN, N. Y.

"AMERICAN"

SIX MILES

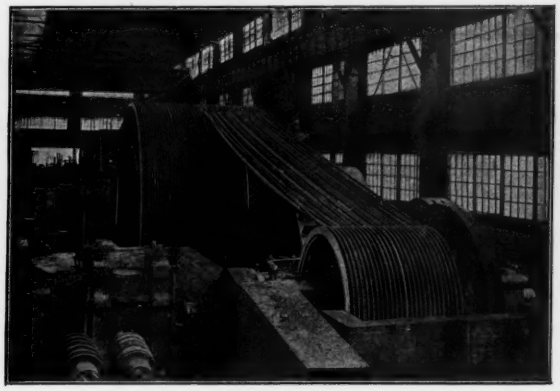
of 2 in. diameter

"AMERICAN"

TRANSMISSION ROPE

used in the INITIAL EQUIPMENT of the drives in this rolling mill.

"American" Rope was selected on account of its great strength and durability, and its well known capacity for carrying heavy, variable loads smoothly and economically.



Although installed five years ago, "American" is still used on these drives.

"AMERICAN" TRANSMISSION ROPE IS STRONG

Because only the finest selected long-fibre Manila hemp is used and every care exercised in its manufacture.

IS NON-STRETCHING

Because it is hard laid under heavy tension so as to eliminate all save initial stretch.

IS DURABLE

Because it is scientifically lubricated with fine pure flake graphite to prevent internal wear, and treated with a special compound to render it waterproof.

Write us for full information on rope driving, and specify "American" when ordering transmission rope.

AMERICAN MFG. COMPANY

Largest Workers of Fibre in the World

65 WALL STREET, NEW YORK CITY

TRANSMISSION ROPE

AMERICAN STEEL & WIRE CO'S

AMERICAN WIRE ROPE

IN ALL STANDARD FORMS OF CONSTRUCTION. NON-SPINNING FLATTENED STRAND & FLAT MADE OF SWEDES IRON, CRUCIBLE CAST STEEL AND MONITOR PLOW STEEL.

HOISTING rope of every description for elevators, mines, coal hoists, ore hoists, conveyors, derricks, stump pullers, steam shovels, dredges, logging, ballast unloaders, etc. Towing hawsers, mooring lines, tiller rope and ships' rigging. Mine and surface haulage rope, street railway cable and power transmission rope, suspension bridge cables, cableway ropes, guy strands and sash cords. Flat rope for deep hoisting. Special rope made to order.

Copper cable and strand for all electrical purposes. Fittings and appliances for use with wire rope

Read about wire rope usage in its different requirements in *American Wire Rope News*. Gladly sent free to anyone upon request.

WE MAKE

American Wire Rope
Aeroplane Wire and Strand
Piano Wire
Mattress Wire
Weaving Wire
Broom Wire
Fence Wire
Flat Wire
Flat Cold Rolled Steel
Wire Hoops
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Tacks, Nails, Staples, Spikes
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Springs
Sulphate of Iron
Poultry Netting
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Shafting Cold Drawn Steel
Wire of Every Description

We issue separate catalog for each of these. Gladly furnished upon application.

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BOSTON	120 Franklin Street
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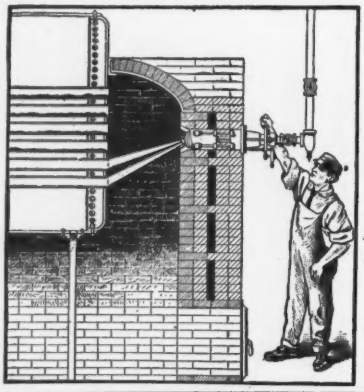
NEW YORK, United States Steel Products Co., 30 Church St. Export Representatives



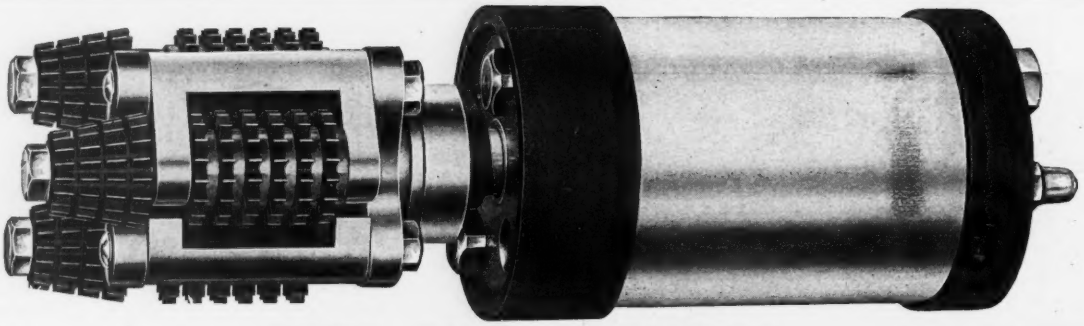
You Can't Do It

You can't get economy from a dirty boiler, or efficiency, or long life, or any other desirable thing.

Install Monarch Flue Blowers

and do away with soot. That's the way to save fuel in your boiler plant.
Write to-day for our proposition. Blowers for all types of boilers.

MONARCH STEAM BLOWER CO., 107 River Street TROY, NEW YORK



Send for Catalog No. 36

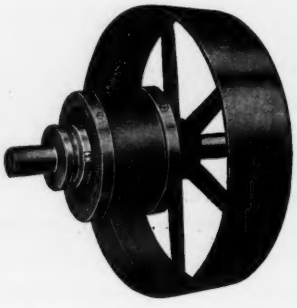
ROTO TUBE CLEANERS

4 times faster than any turbine.

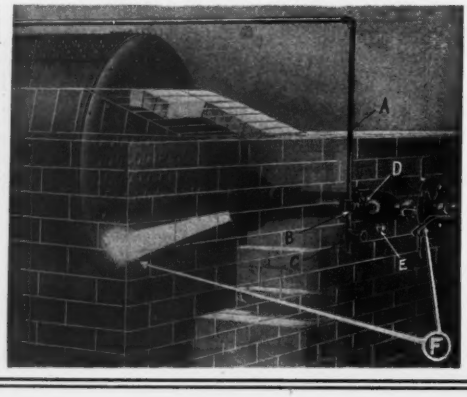
THE ROTO COMPANY
Hartford, Conn.

Do You Need a Good Clutch?

Then investigate the Akron!
Its many distinct advantages and its applicability to a wide variety of machines make it a safe and profitable investment on any transmission line.
For instance, its disc construction causes all pressure to be in line with the shaft and makes it suitable for high speed work. When it is fully engaged or disengaged there is no end thrust. Large friction surfaces insure maximum power and service with minimum wear on parts. Easily applied, as the entire operative mechanism is handled as one piece.
Compact—takes up little room on the shaft, is easy to operate and action is smooth, positive and silent. If you have a place for a good clutch write for details about the Akron
Built in sizes ¾ to 225 H. P. at 100 R. P. M.



THE WILLIAMS FOUNDRY & MACHINE COMPANY, Cherry Street, AKRON, OHIO



Let Your Coal Man Pay The Bill

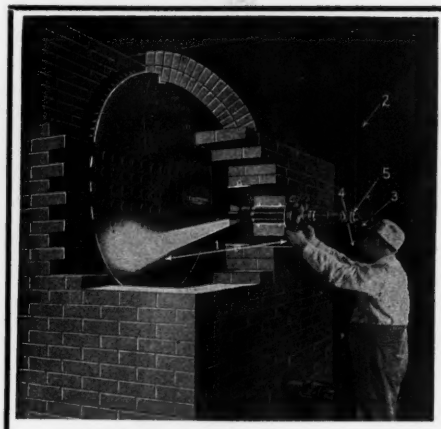
If your coal dealer offered to allow a 10% discount from your monthly bills and still deliver the same quality, you would be quick to sign a contract.

By Equipping Your Boiler with the

Marion Rotary Flue Blower

you turn the imaginary proposition into a real one, the only difference being in the way the saving is made. It's the coal man's loss and your gain.
We will send you one or more Marion Rotary Flue Blowers built to fit the boilers in your plant, on 30 DAYS' TRIAL. If they fulfill our broad guarantee, the coal man pays the bill. If not, return them at our expense and make no excuse for doing so. It's all up to you.

Marion Machine Foundry & Supply Co., P. O. Box 400 Marion, - Indiana



The Efficiency of the Man depends on the Efficiency of the Equipment

That's One of the Reasons it pays to have the

HOOSIER SOOT BLOWER

installed on your boilers. Old dirty methods of cleaning are done away with and the time saved can be profitably applied in some other way.

Three minutes time cleans the tubes thoroughly. Nothing to do that means work. No shutting down — no muss to clean up afterwards, and anybody can do the job in their Sunday Clothes.

30 DAYS' TRIAL in your own plant will prove our guarantee of a 10 per cent saving in fuel. The HOOSIER will soon pay for itself in the coal it saves and cut off expense in many other ways.

Get the particulars of our trial offer by return mail.

CENTRAL MACHINE & FOUNDRY CO.

P. O. Box 298 Marion, Indiana

THE "TORNADO" BOILER TUBE CLEANER

Sent on Trial.

not only does the work better than any other cleaner, but does it in shorter time and more economically.

BECAUSE

the air injected by a small volume of steam carries no moisture to wet the soot, but blows it out through the longest tubes.

THE PAUL B. HUYETTE CO., Inc.

HIGH GRADE STEAM SPECIALTIES

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That will be the satisfactory way to determine the value to you of the

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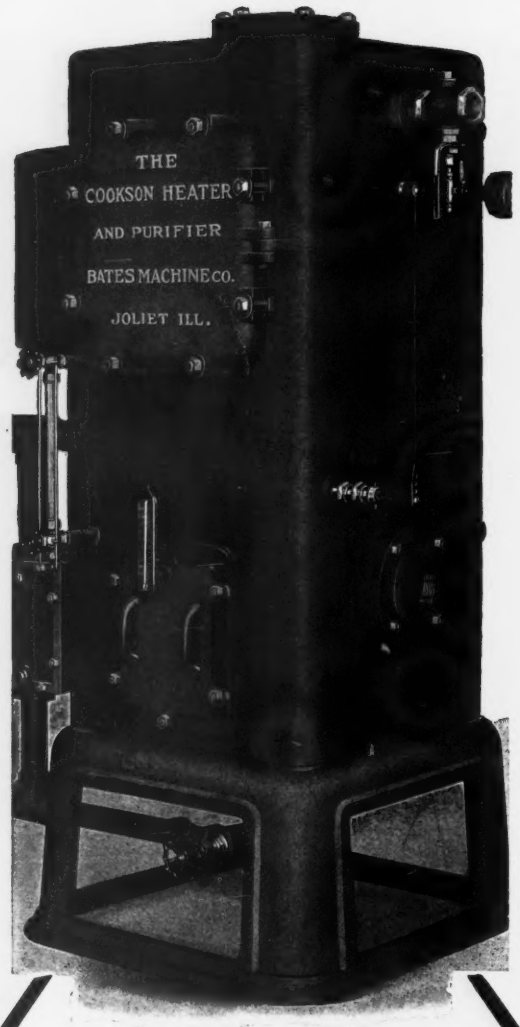


A Small Cookson Heater For Small Plants

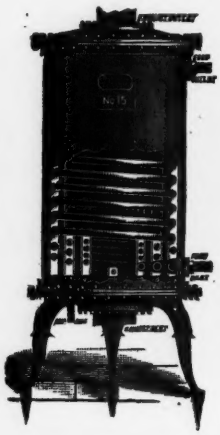
This Cookson Junior Heater is thoroughly first class; in every respect, full-fledged apparatus with all the refinements and economies of our larger types, absolutely reliable in every way, an improvement to any boiler room, and a money-maker for the owner of any small power plant.

We make this heater with or without cut-out valve in oil separator, and with trap or water seal in overflow as needed. If your requirements are between 50 and 200 h. p., whether you have vacuum or back pressure heating system, or are exhausting direct to atmosphere, it will pay you to investigate this Cookson Junior Heater. Our line includes cylindrical, rectangular, steel plate and cast iron heaters and purifiers for every condition. Write for catalog.

BATES MACHINE COMPANY

Builders of Cookson Heaters and Purifiers and Bates Corliss Engines 22

710 Henderson Avenue JOLIET, ILL.



YOU WON'T FAIL TO GET

PERFECT SERVICE

FROM A

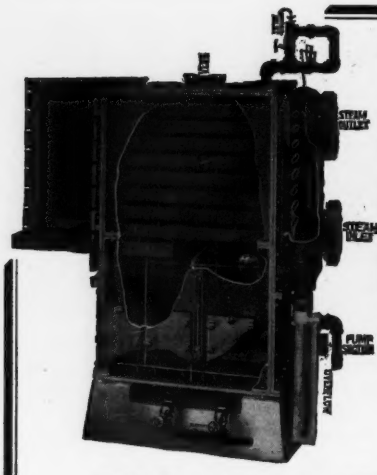
NATIONAL FEED-WATER HEATER

It is the simplest heater made, yet the most effective one, because it has no inside joints to leak and the water does not come in contact with the shell or iron.

It absolutely insures against back pressure, grease in the boiler and waste of fuel.

We have a booklet on Feed Water Heating for you. Send us your address.

THE NATIONAL PIPE BENDING CO.,
157 Lloyd St., New Haven, Conn.



The Stickle Open Heater and Purifier

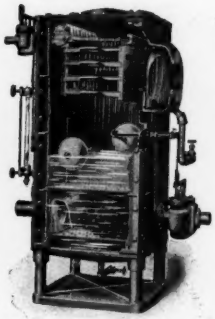
This is strictly an OPEN HEATER of the Tray Type. The words "Open Coil" are descriptive of the course the water takes over the tray surface.

This heater is easy to clean. Our catalog tells why.

Open Coil Heater & Purifier Co.

502 South Pennsylvania Street, Indianapolis, Indiana

Ask for descriptive catalogue, at the same time we will enclose you one of our Steam Trap catalogues, the most complete line in the market today.



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Blake-Knowles

OPEN

FEED WATER

HEATER

It combines the functions of a Feed Water Heater, Oil Separator, Purifier and Automatic Receiver.

Increased Boiler Efficiency and decreased Labor and Fuel Costs are the results of its use.

Fully described in Bulletin B. K. 84751

The Blake & Knowles Steam Pump Works

New York: 115 Broadway

Works: East Cambridge, Mass.

Branch offices in all large cities BK150.2

The guarantees that go with the

OTIS

Feed Water

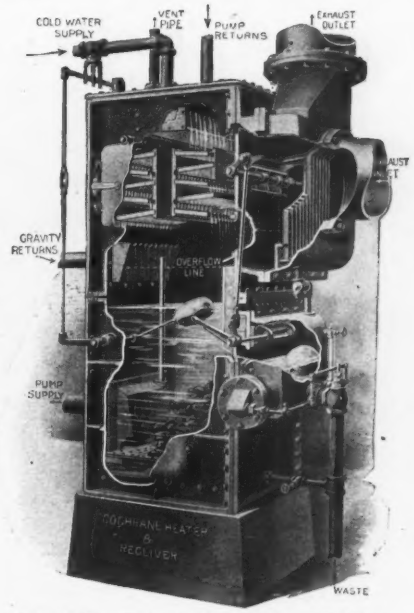
Heater

positively protect the buyer from any loss. If the Otis fails in any one of them, we are the losers. A few of these guarantees are: That the Otis by means of exhaust steam will heat the feed water to 210 deg. or above; that it can be more easily and thoroughly cleaned than any other tubular heater; that it will not get foul with scale; that it reduces back pressure; that it will deposit all impurities that precipitate at 210 deg.

Our bulletin gives all of the guarantees and tells why the Otis is qualified to live up to every one of them. Tell us where to send it.

STEWART HEATER COMPANY

7 Norfolk Avenue, Buffalo, N. Y.



Interior View Cochrane Steam-Stack and Cut-Out Valve Heater and Receiver.

COCHRANE HEATERS REDUCE STEAM PLANT EQUIPMENT COSTS

APART from the coal and water that a Cochrane Heater will save, it will reduce the first cost of the plant.

A COCHRANE

Steam-Stack and Cut-Out Valve Heater and Receiver

for instance will save the cost of an independent oil separator, and of the traps, valves, elbows and piping required to install it in a by-pass around the heater.

The Cochrane Steam-Stack and Cut-Out Valve Heater and Receiver is equipped with an oil separator large enough to purify of oil all the steam delivered by the engines and pumps, including that which passes to the heating or drying system, low pressure turbine, absorption ice machine, or other exhaust-steam-using appliance.

Frequently you can save one-half or more of the cost of the Cochrane Heater right off, in the valves and piping that it will render unnecessary. Then these heaters are "Fool-Proof", the kind you want.

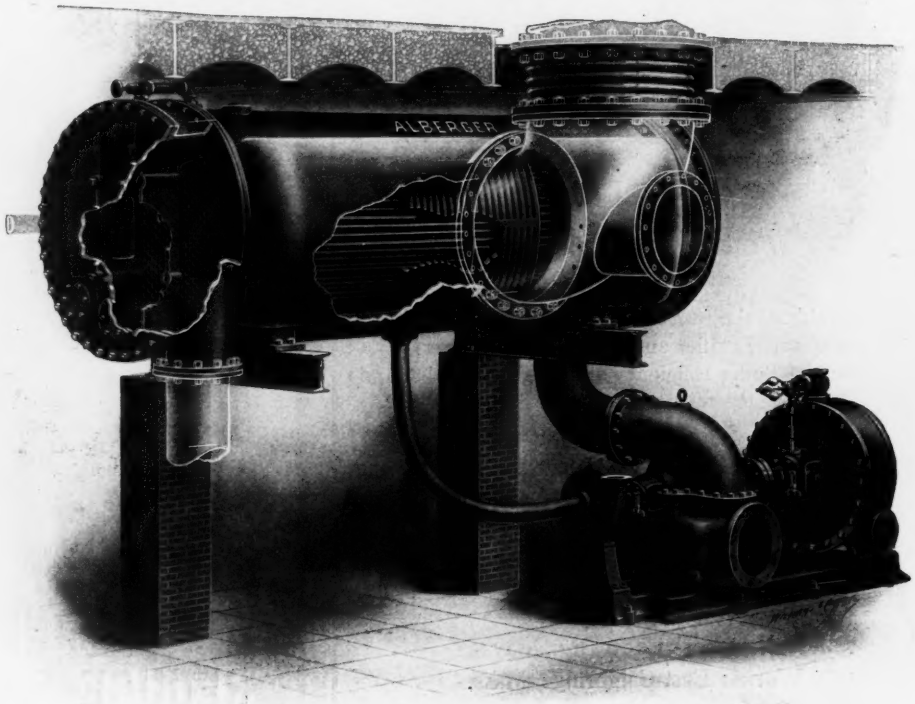
Send us a sketch, with particulars relating to your plant, and let us show how this is.

HARRISON SAFETY BOILER WORKS

3144 N. 17th Street PHILADELPHIA, PA.

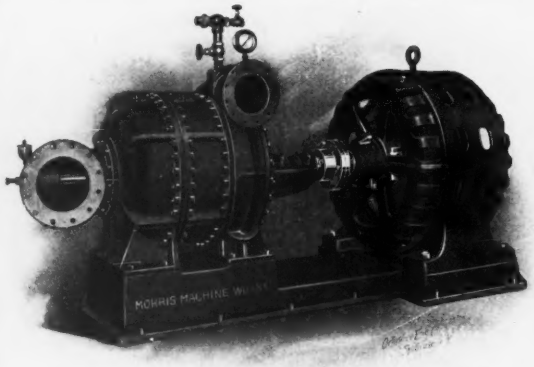
Horizontal Counter Current Flow of Steam and Water

Large space for complete distribution and free circulation of steam. High temperature of condensation. Low head room.



ALBERGER CONDENSER COMPANY
140 CEDAR STREET
NEW YORK CITY

Chicago San Francisco
Pittsburgh Boston
St. Louis Atlanta.



Morris Electrically Driven Centrifugal Pump for Water Works

This 10-inch, three stage pump, direct connected to electric motor, exemplifies a very popular pumping unit in water works and wherever any capacity is desired in most compact space.

MORRIS PUMPS are peculiarly adapted for this purpose on account of their high speeds. Owing to their noiseless operation, the little and unskilled attention required and the ease with which they can be erected and maintained, such outfits are in extensive use.

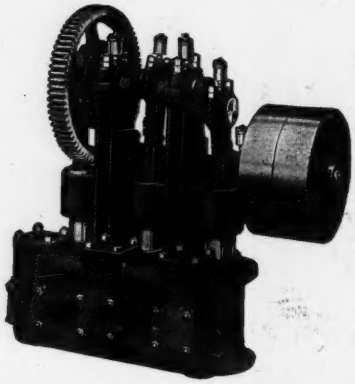
Built in sizes from ¾-inch up to 48-inch discharge, and for any type of motor.

Why not write for our catalog showing full line of centrifugal pumps?

Morris Machine Works

New York Office, 31-41 Cortlandt St. Baldwinsville, New York, U.S.A.
HENION & HUBBELL, Agts., 221-223 N. Jefferson St., Chicago
H. A. PAINE, Agt., Houston, Texas Southern Office, Charlotte, N. C.

Deming Power Pumps
Best For Boiler Feeding



Can be Driven by the Surplus Power from Line Shaft

WRITE

The Deming Company
Salem, Ohio.

Hand and Power Pumps for all uses

Henion & Hubbell, 221-223 North Jefferson Street, Chicago
Harris Pump & Supply Company, 320-322 Second Ave., Pittsburgh, Pa.
Ralph B. Carter Company, 152 Chambers St., New York
Other Agencies in all Large Cities

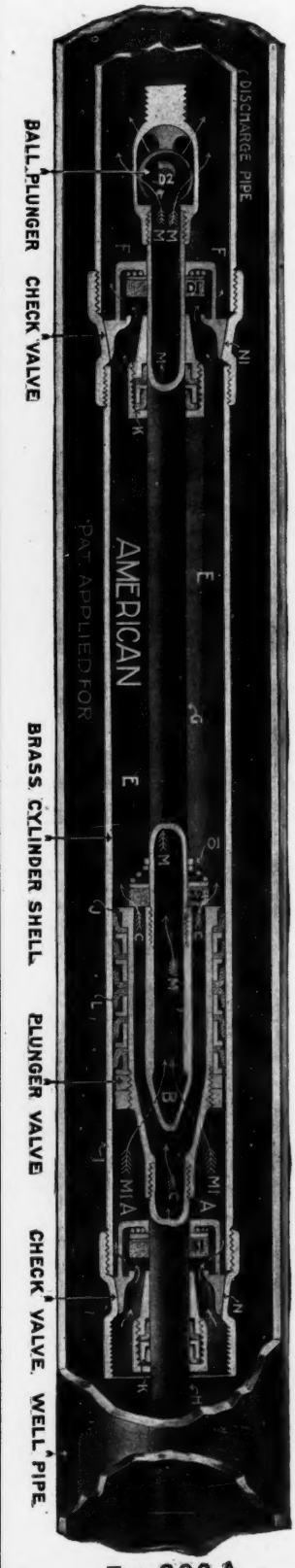
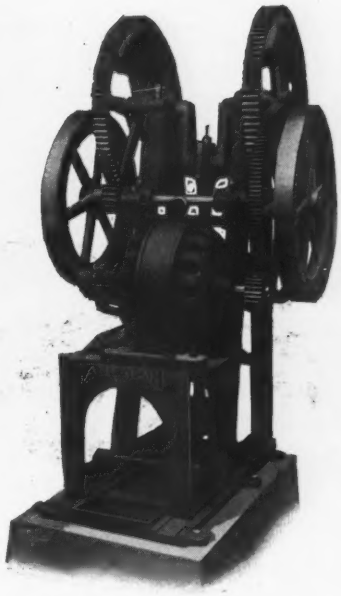


FIG. 380 A

The Reason No Other Deep Well Pump Equals an "American"

It's not alone the nearly 42 years we have been making these pumps, it's not due to the fact that they are now in use in nearly every country in the world, and not because we make more of them than any other concern in America, but for the reason that they represent the fulfillment of achievement of a lifetime's experience of a large organization with a constant effort to build the best deep well pump that can be produced.



The **"American"** pump is not an invention, it's an evolution—a constant study of a corps of engineers and experts in pump design until it is developed to the limit of human attainment.

"American" water cylinders are made in both single-acting and double-acting styles, both made of brass construction, the cast portions cast in our own brass foundry and the entire cylinders built under the direct supervision of our own experts.

Examine critically the construction of the double-acting cylinder in the accompanying illustration.

It's not double-acting in name alone, but delivers full plunger displacement capacity on both the up-stroke and the down-stroke.

AMERICAN

There's a solid brass shell, a cast brass plunger and cast brass fittings with hard leather cupped washers secured between brass bushings, fitted in the most careful possible manner and so designed that all valves are drawn from the well with the plunger.

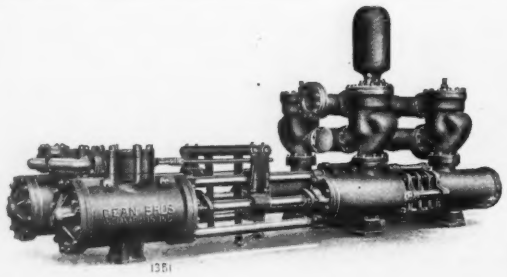
"American" Deep Well Pumps are best because they not only represent greatest experience and largest output, but are made of best material and by the most skilled workmen obtainable.

Made in any size to the largest built, equipped with steam heads, pump jacks or direct geared to motor.

Write for the most complete Deep Well Catalog ever issued, No. 110.

The American Well Works

General Office & Works: Aurora, Ill., U.S.A.
Chicago Office: First National Bank Building



DEAN BROS. STEAM PUMP. WORKS. INDIANAPOLIS.

NOT IN THE PUMP TRUST.

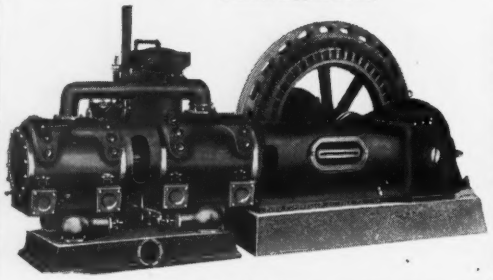
This DUPLEX OUTSIDE PACKED PLUNGER POT VALVE PUMP is for pumping against 250 lbs working pressure. It is an ideal boiler feed pump, having deep stuffing boxes and simplified valve movement. The Valves are in cages easily accessible through the large hand hole plates.

SEND FOR CATALOGUES

BURY COMPRESSOR COMPANY, ERIE, PA.

New Bury Variable Volume Air Compressor Type VCC4ESO

(Patent Applied For)



Built as shown below, for Power, Steam or Gear Motor Driven. Cut illustrates a 2,000 ft. capacity per minute machine with synchronous motor mounted directly on shaft. Write for Illustrated Circular.

All Sizes—All Types—For All Pressures. We solicit your Inquiries.

BUILT for day and night, year-in-and-year-out service—Atlas Engines.

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INDIANAPOLIS

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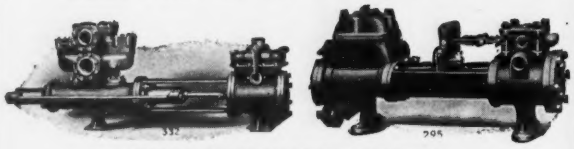
THE WORLD RENOWNED CENTER FOR HIGH GRADE MACHINERY

STEAM PUMPS

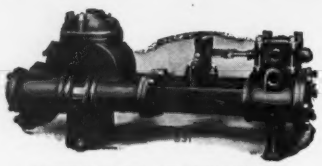
SINGLE AND DUPLEX

BUILT FOR ALL PRACTICAL PURPOSES



PISTON, PLUNGER AND RAM PATTERNS
FOR LIGHT, MODERATE AND HEAVY PRESSURES

For Mills, Mines, Factories, Power Plants



For Municipal Water Works Installations

SURFACE AND JET CONDENSERS

IF you want to know about our improvements in our line that insure high efficiency and low cost of maintenance, send for our new

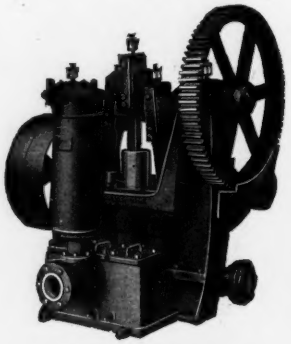
Catalogues 307 and 317 now in preparation.

THE JOHN H. McGOWAN CO.

Goulds Triplex Power Pumps

are made in all capacities for every class of service.

In strength, efficiency and durability they are unexcelled.



For over half a century "Goulds" has stood for the best in pump manufacture.

Send for Catalog.

THE GOULDS MFG. CO.

57 W. Fall St. Seneca Falls, N. Y.

16 Murray St., New York 58 Pearl St., Boston

Branches in all large cities

K & E STEEL TAPES

All **K & E Steel Tapes** are now made with our **KECO** finish and bright steel graduations.

The new **KECO** finish is a safeguard against rusting due to humidity or to moisture imparted through handling. The bright steel graduations in strong contrast with the jet black background effectually prevent errors due to incorrect readings.

Owing to wear, the nice adjustment of the center of tapes suffers in time, resulting in difficulties when winding or unwinding the tape. All **K & E** Measuring Tapes are now made with **Compensating Centers,** allowing adjustment for wear in the center and giving just the friction desired.

May we send you our latest tape circular?

KEUFFEL & ESSER CO.

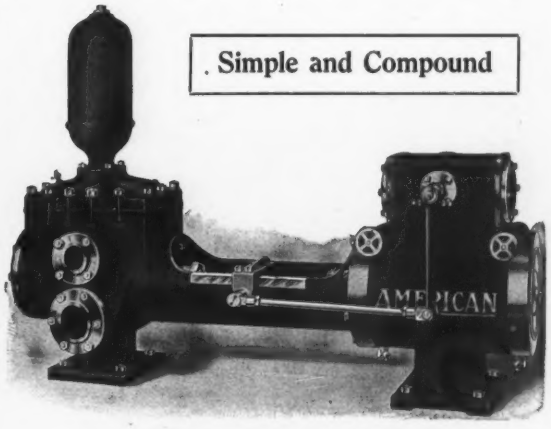
127 Fulton Street, NEW YORK — General Office and Factories, HOBOKEN, N. J.

CHICAGO ST. LOUIS SAN FRANCISCO MONTREAL

Drawing Materials, Mathematical and Surveying Instruments, Measuring Tapes

American Steam Pumps

Simple and Compound



The Secret of Economy

in a steam pump lies in the design and manufacture of the steam valve. AMERICAN STEAM PUMPS have valves of the piston type. They are ground to a fit with the valve chest bushing and are fitted with rings ground to a fit on both sides and circumference. There is no leakage of steam past these valves.

We guarantee a lower steam consumption on our pumps than any other manufacturer of direct acting pumps.

ASK FOR CATALOG No. 18

AMERICAN STEAM PUMP CO.

BATTLE CREEK, MICH.

The One Sure Way

to avoid costly experiments is to use the famous time-tested

MONCRIEFF

Scotch Gauge Glasses

Glass Tubes
(with or without red line)
Cylindrical Glasses
Lubricating Glasses

We are Sole Agents in the U. S.

Write us about anything you need in Tools or Supplies

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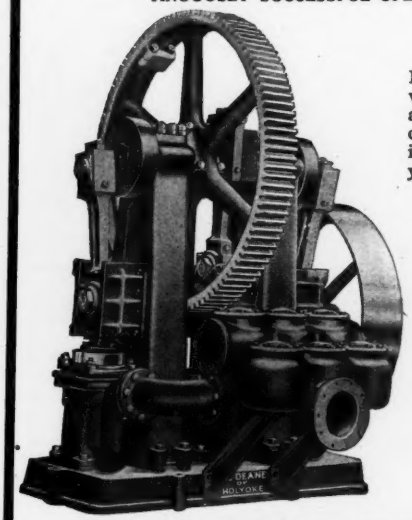
YEARS OF EXPERIENCE IN BUILDING PUMPS FOR THE MOST EXACTING SERVICES ASSURE YOU THAT IN ALL

DEANE PUMPS

ARE BUILT THE QUALITIES NECESSARY FOR CONTINUOUSLY SUCCESSFUL OPERATION



Deane engineers will be pleased to advise you concerning any pumping problem that you may have.

Correspondence invited.

Our latest bulletin, D-204-51, tells about Triplex Power Pumps. Send for it.

DEANE STEAM PUMP CO.

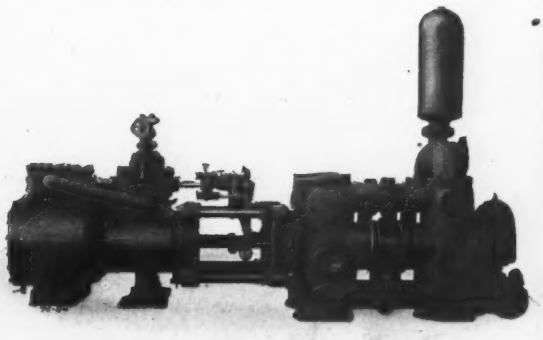
Works: HOLYOKE, MASS.

New York Office: 115 Broadway D 141-2

Sales Offices—New York, Boston, Philadelphia, Pittsburgh, Atlanta, El Paso, Denver, St. Louis, Cleveland, Detroit, Cincinnati, Kansas City, New Orleans, San Francisco, Los Angeles, Seattle, Chicago, London.

Pumping Dependability

Back of the design and construction of every Worthington Pump is a specialized knowledge of pumping conditions.



The Worthington Outside Packed Plunger Pump, for example, is adapted for rough, heavy service. It is especially desirable where the water contains quantities of sand and grit. Our Engineering Department is ready to aid you in selecting the correct type and size for your needs.

Write for Catalogue W-170-51.

HENRY R. WORTHINGTON

115 Broadway New York City

W131.2

In 1902 The Amoskeag Mfg. Co., Manchester, N. H., installed 12 Jones Stokers. In September, 1911, they sent their eighth order and now have

192 JONES STOKERS

These Stokers Are Installed In Their Various Plants

The Jones Under-Feed Mechanical stoker is successful because it gets highest possible combustion from any grade of bituminous fuel, because it gives instant and automatic response to change of load, eliminates the smoke nuisance, and has extremely low cost of maintenance.

It pays for itself and then pays dividends—in the small plant as well as the large one.

Find out about it. Write for Jones Catalog today.

The general superintendent advises that the 12 stokers originally installed have cost $12.00 for repairs.

One Dollar Apiece For Repairs. In Nine Years

The Under-Feed Stoker Company of America

General Offices: Harris Trust Bldg., Chicago

New York Philadelphia Boston Pittsburgh Detroit Buffalo Cincinnati Toledo
Minneapolis St. Louis Kansas City Denver

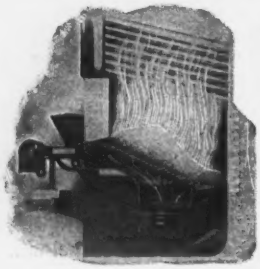
THE LAW SUIT WAS DROPPED

Ever been in Cleveland?

Part of the city—the residential district—is clean enough to want to stay clean.

But there's a power plant there, and the smoke caused much complaint. The smoke inspector made life miserable for the chief engineer.

To make matters worse, the committee, appointed by the Chamber of Commerce, determined to bring suit against the owners on account of violation of the smoke laws.



But—the suit was dropped when they told the Committee that they would install three

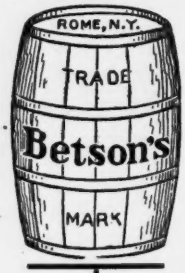
TAYLOR STOKERS

So much for a reputation for Smokelessness.

American Ship Windlass Co.

General Sales Office and Works **Philadelphia, Pa.** (15-83)

Boston Cleveland New York Detroit Philadelphia Milwaukee Pittsburgh St. Paul Baltimore Cincinnati



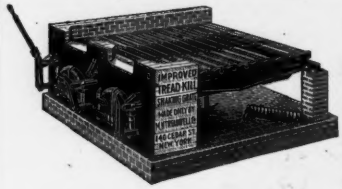
Have a Barrel Handy

DO YOU WANT TO CUT DOWN BOILER ROOM EXPENSE?

Then use Betson's Plastic Fire Brick on the "weak spots" in the fire brick lining. Fill in these bad places and you'll make the entire lining last much longer. The forces of expansion and contraction are neutralized in Betson's Fire Brick, hence it does not crack or fall out. Order a barrel. It comes moist so that it is easily applied. Sets quickly. You can make a solid one-piece boiler door arch or side wall lining.

Ask us for full particulars.

BETSON PLASTIC FIRE BRICK CO., ROME, N. Y.



"TREAD-KILL" GRATES SHAKING DUMPING

Over 10,000 successful installations testify to their unfailing convenience and economy

Write today for "Tread-Kill" Souvenir Booklet and learn *why* "Tread-Kill" Grates are money savers.

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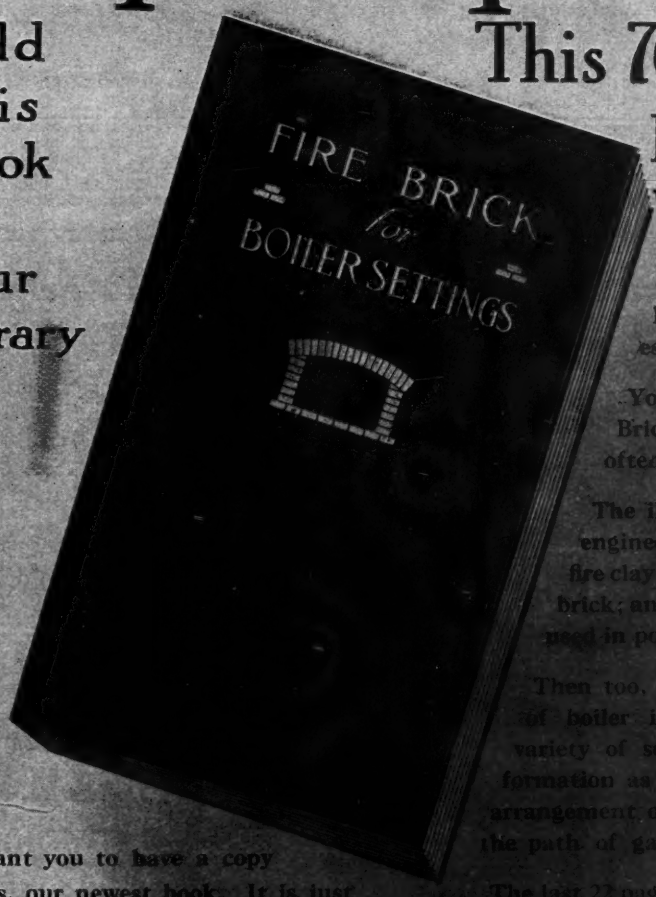

This 76 Page Book on Fire Brick for Boiler Settings Will be sent you-Free!

This is not merely a catalog describing Fire Brick, but is a short treatise written especially for Engineers.

You will find it filled with facts about Fire Brick and how they are made—facts not often brought to the Engineer's attention.

The illustrations are full of interest to every engineer. They show the process of grinding fire clay; of molding, tempering and burning fire brick; and the many standard and special shapes used in power plants.

Then too, you will find photographic illustrations of boiler installations. These pictures show a variety of settings. From them you can get information as to each type of boiler, the shape and arrangement of the furnaces, the position of baffles, the path of gases, etc. It is information you want.

The last 22 pages contain tables on brick and temperatures. These are largely original tables, accurately worked out by our engineers. They are in convenient form for ready reference. You need and will use them constantly.

76 PAGES OF UP-TO-DATE BOILER SETTING INFORMATION.

We want you to have a copy of this, our newest book. It is just off the press and will be sent you free. It contains 76 pages, size 4½" x 6⅜", printed on heavy, serviceable white enameled paper, with illustrations and decorations in two colors, bound in double heavy paper covers.

Simply fill in, tear out and mail the coupon and this book will be promptly sent you by return mail. The entire first edition will be quickly exhausted and we suggest that you send in a request for your copy immediately.

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Pittsburgh, Pa.

Gentlemen: Please send me, FREE of cost a copy of book "Fire Brick for Boiler Settings," as illustrated and described in December Practical Engineer.

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We have a Large Shop at both St. Louis and Phoenixville, Pa. Both are thoroughly equipped for promptly executing large orders of large units. SIZES 70 H. P. TO 700 H. P.

"BOILER LOGIC" and "SUPERHEATER LOGIC" tell about our Product. FREE!

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THE BABCOCK & WILCOX COMPANY,

85 LIBERTY STREET, NEW YORK

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WATER TUBE STEAM BOILERS

STEAM SUPERHEATERS. MECHANICAL STOKERS.

Works: BARBERTON, OHIO; BAYONNE, N. J.

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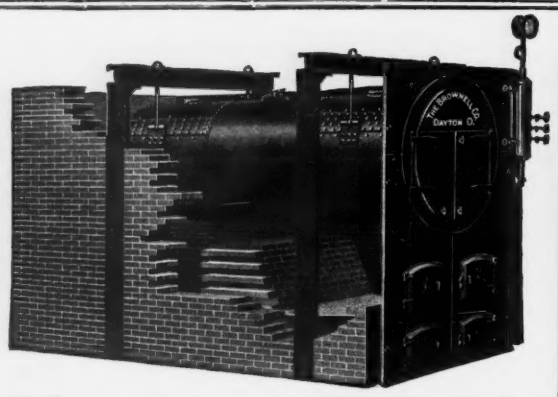
Cincinnati.....Traction Building	New Orleans.....Shubert Arcade	San Francisco.....99 First St.
Cleveland.....New England Building	Philadelphia.....North American Building	Seattle.....Mutual Life Building



Brownell

Boilers, Engines and Feed Water Heaters

Our 1911 Catalog mailed on request

THE BROWNELL COMPANY,
(Established 1855)
Main Office and Works: DAYTON, OHIO

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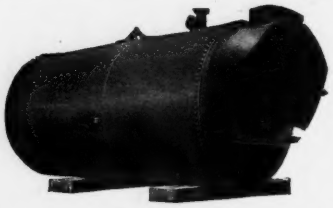

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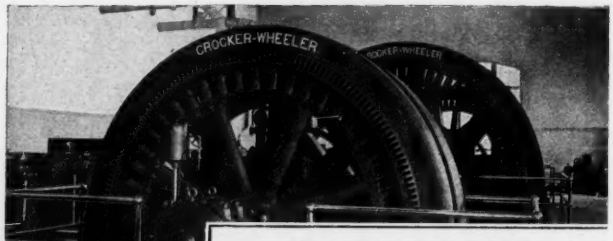
SCOTCH BOILERS

DRY AND WATER-BACK

Also Improved Manning Vertical Boilers and Special Boilers for Steam Heating.



Power Plant of Elgin Watch Co.

This is only one of many plants where CROCKER-WHEELER A. C. GENERATORS have made good.

We can name hundreds of others.

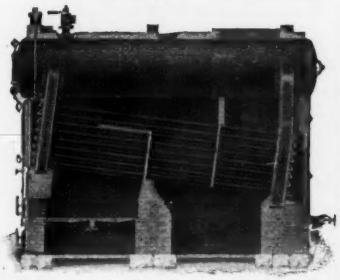
CROCKER-WHEELER COMPANY
AMPERE, N. J.

"GEARY" WATER TUBE BOILERS

ALL FLANGE STEEL CONSTRUCTION

Sizes 50 to 650 H. P.

A product of a new, modern shop, thoroughly equipped for promptly executing orders of large units as well as small.



OIL CITY BOILER WORKS . . . . . Oil City, Pa.
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Fire and Water Tube Boilers

All Wrought Steel Construction

Established 1865.

E. KEELER COMPANY

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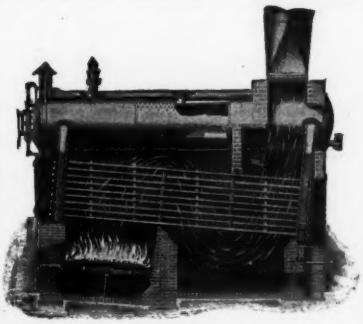


WICKES
Vertical Water Tube Boiler

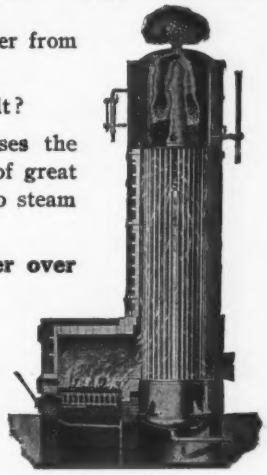
Did you ever pull water from boiler with engine?

Do you know the result?

The Wickes Boiler uses the old plug-hat dome idea of great height from water line to steam outlet.

You don't pull water over from this boiler.

Ask us for bulletins —sent free.



The Wickes Boiler Co.
Main Office and Works, SAGINAW, MICHIGAN

SALES OFFICES: 1411 West Street Building, West and Cedar Sts., New York City, 269 Richmond Ave., Buffalo, N. Y. 1139 American Trust Bldg. Chicago, Ill. Penobscot Bldg., Detroit, Mich. Empire Bldg., Pittsburg, Pa. 918 Brown-Marx Bldg., Birmingham, Alabama. 22 State St., Grand Rapids, Mich. Seattle, Wash.

THE FREEMAN INTERNALLY FIRED BOILER

ECONOMICAL, SAFE AND DURABLE

Made in Sizes from 50 H. P. to 300 H. P.

Our Shops are equipped for turning out the highest class of steel plate work of any description. Send in your specifications and our Engineering Dep't will be pleased to give them prompt attention.

Catalogue upon request.

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THE S. FREEMAN & SONS MFG. CO.

CHICAGO OFFICE: 1726 Marquette Building

CHARCOAL IRON BOILER TUBES

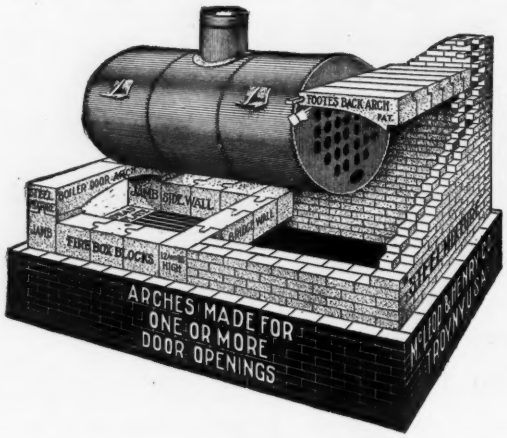
The most modern tube mill in America.
Charcoal Iron Tubes only are made.

Parkesburg Iron Company
Parkesburg, Pennsylvania

Philadelphia New York Chicago

The Best Fire Box Lining

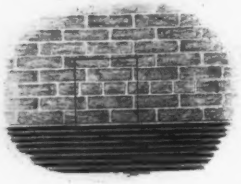
"STEEL MIXTURE"

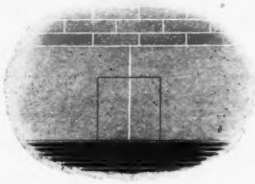


"STEEL MIXTURE"

The large block form of construction has so many things to commend it that it is being adopted by engineers all over the country. Such blocks can be combined in a variety of ways to line side walls and bridge walls according to your individual ideas.

They present a smooth and durable surface which withstands the action of the fire better than small brickwork. This is largely due to the absence of joints. It can easily be seen from the small cuts that a square foot of brickwork has many more joints than an equal area of block surface. Clinkers do not stick to the latter as readily as to the wall with the numerous joints and are removed without danger of loosening some of the bricks and weakening the wall. The unbroken wall is also tighter and less liable to air leaks.





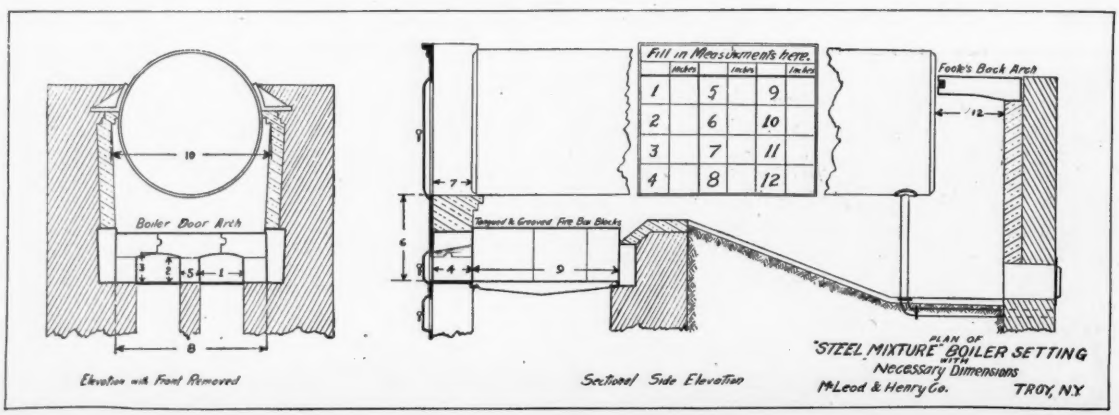
The "Steel Mixture" blocks come in three heights, 12", 18", and 24"; and three thicknesses, 6", 8", and 9". They are all tongued and grooved so as to remain tightly held together.

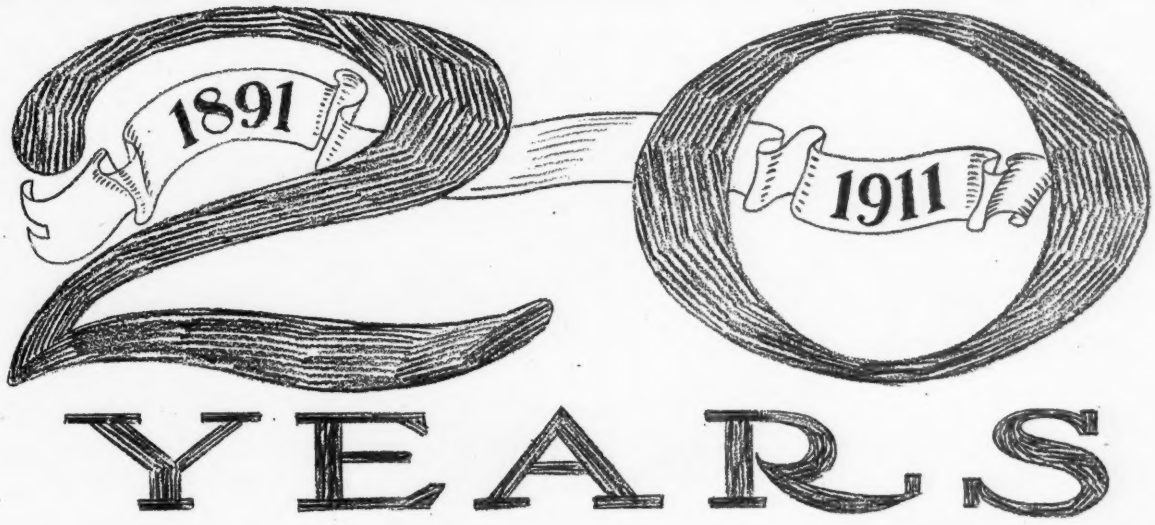
The material is specially produced for boiler setting use. It stands high heat and is also hard and tough so as to resist abrasion. Its somewhat coarse texture enables it to undergo expansion and contraction—a most necessary quality for a material which is to be moulded into large blocks.

You can improve your boiler furnaces by adopting these blocks. We keep them in stock all the time together with the other "Steel Mixture" products, boiler door arches and back arches. You can get just what you want to fit practically any boiler. In order to quote prices we have to have the measurements called for on the diagram below. Send these to us and we will quote you at once.

McLeod & Henry Co., Troy, N. Y.

New York Office, 1402 Broadway


Fill in Measurements here.
Inches
Fook's Back Arch
Boiler Door Arch
Tongued & Grooved Fire Box Blocks
Elevation with Front Removed
Sectional Side Elevation
PLAN OF "STEEL MIXTURE" BOILER SETTING WITH Necessary Dimensions
McLeod & Henry Co. TROY, N.Y.



ALLAN RED METAL

HAS STOOD THE TEST OF TIME

In 1891 the gross sales of Allan Red Metal did not amount in cash, to the cost of the space occupied by this advertisement for a like period. Yet those sales were the cornerstone in the foundation upon which has grown a demand for millions of pounds of Allan Red Metal for bearings, metallic piston rod and valve stem packings and for facing pistons.

The year 1891 was the experimental period in our business life, when we sought to demonstrate our claims that cast iron pistons working in cast iron cylinders was not the best engineering practice — that scoring of cylinders could be overcome—that a great reduction in friction and wear on cylinder and piston could be accomplished—thereby increasing the efficiency of the engine and reducing maintenance cost.

Our progress from 1891 to 1911 has substantiated these claims by the fact that during the past Twenty Years we have sold for facing pistons over 5,000,000 pounds of Allan Red Metal. Progressive Engine Builders, Mechanical and Operating Engineers, who aim to keep their engines abreast with the times and maintain the Highest Standard of Efficiency, recognize Allan Red Metal faced pistons as the MOST advanced design in piston construction.

Our booklet—"The Heart of the Engine—The Seat of Power"—will be mailed free upon request. Every Engineer should read this booklet; it's a treatise on piston design.

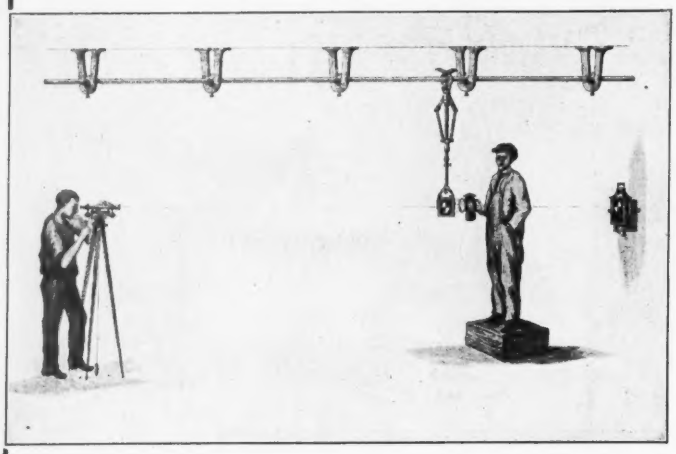
A. ALLAN & SON

484 Greenwich Street

NEW YORK

20 HORSE POWER SAVED IN ONE ROOM

A North Carolina mill writes: "We consider it the best investment we have made in some time: in one room we saved 20 h p."



Knoxville, Tenn., 9/18, '11.
Kinkead Mfg. Co.

Gentlemen:—To say that we are pleased with the outfit would be putting it mildly indeed. We believed our shafting was kept in as perfect alignment as possible without the use of your outfit, but since we have started to use your outfit we are convinced that **every mill in this country that is not equipped with an outfit is losing power by shafting friction.** We would not take many times its cost if we could not purchase another like it.

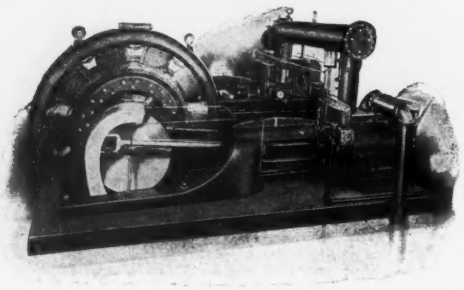
Brookside Mills,
L. H. Brown, Supt.

Use the ***KINKEAD APPARATUS*** in your plant. See that the line shafting is in proper shape. You will be surprised at the saving in power. Let us give you a ***FREE DEMONSTRATION.***

SEND FOR CATALOG F.

KINKEAD MANUFACTURING COMPANY, 7 Water Street, Boston, Mass.

Cincinnati and Climax Air Compressors



Are built in a great variety of types and sizes. No compressor is suitable for all conditions, but for any set of conditions there is one compressor that is most efficient, durable and otherwise satisfactory.

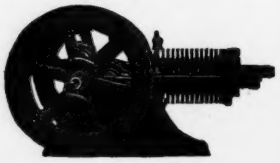
With our experience we can help you select the best compressor for your particular requirements.

If you do not know our lines, write for bulletin L-521-51-A.

The Laidlaw-Dunn-Gordon Co.
New York Office: 115 Broadway Works: Cincinnati, O.

L-128.2

Superior Gas and Gasoline Engines



The Gilson is a sturdy and reliable Engine of the four-cycle type. It is simple and strong in construction, and economical in operation; material and workmanship are of the best, and every Engine is guaranteed to deliver more than its rated horsepower. Built in all sizes.

Write for our Catalog.

GILSON MFG. CO., Port Washington, Wis.

"THE LITTLE BIG ENGINE"

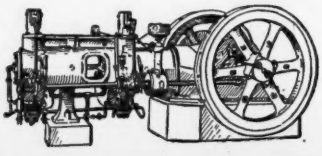
20 TO 200 H. P.

Here is an engine that is built along lines that have proven best by test and during actual operation for long periods under hardest conditions.

It makes good. That is its invariable record. And the number in use makes the record complete and convincing.

Those things that make big gas engines reliable and economical are all present in the design, construction and workmanship of this engine.

Our direct-from-the-factory Sales plan is a decided advantage in your favor. Write for Bulletin No 22.



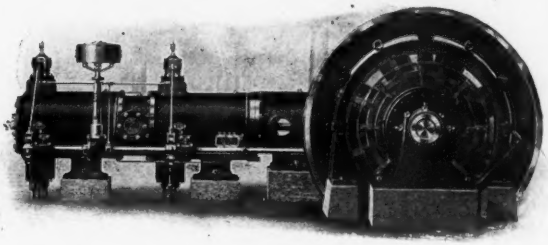
The Elyria Gas Power Co.
Elyria, Ohio

YOU CAN DELIVER ELECTRIC CURRENT

EITHER A. C. OR D. C. AT YOUR SWITCHBOARD

AT A LOWER COST

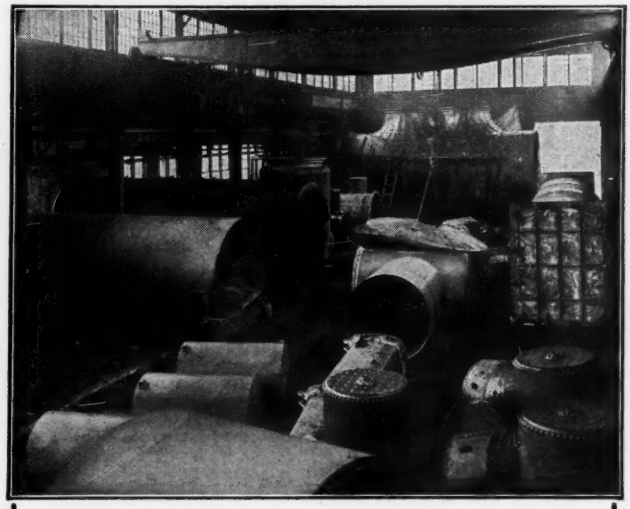
THAN BY BUYING FROM A CENTRAL STATION
BY INSTALLING A



BOGART GAS ENGINE AND PRODUCER GAS PLANT

Write for details applying to your plant

BOGART GAS POWER ENGINEERING CO.
COMPLETE PLANTS
MAIN OFFICE:
BUFFALO, N. Y.



RIVETED or WELDED TANKS

FOR STORAGE AND FOR PRESSURE

and a General Line of

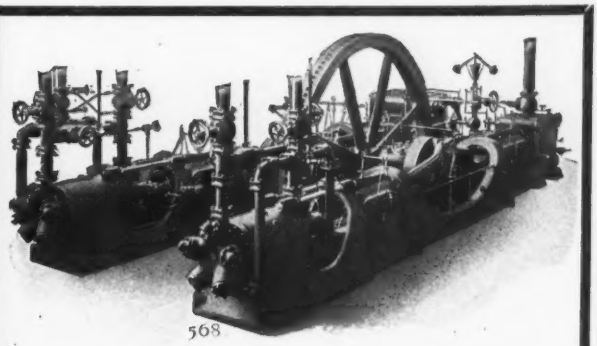
STEEL PLATE CONSTRUCTION

For

OIL REFINERIES, SUGAR REFINERIES, SOAP FACTORIES, WOOD ALCOHOL AND TURPENTINE PLANTS

Agitators, Filters, Coolers, Steam Pans, Penstocks, Retorts, Stills, Condensers, Jacketed Kettles, Riveted Pipe, Brick Hardening Cylinders, Cyanide Tanks

STRUTHERS-WELLS CO., - - Warren, Pa.
NEW YORK OFFICE, 50 CHURCH STREET



York Standard Double-Acting Duplex Machine.

With three suction and two discharge valves in each compressor head, and containing the best proportioned and most liberal valve area (to rated capacity) of any horizontal machine on the market. Bulletins 15 and 45.

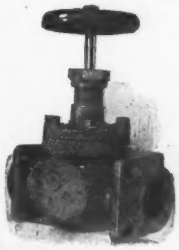
YORK
ICE MACHINES

Comprise all sizes and types of both the Compression and Absorption Systems of Ice-Making and Refrigeration

We are, therefore, in a position to give absolutely impartial and reliable advice as to the equipment best suited for your purpose, if you will state your conditions as to steam pressure, temperature and quantity of condensing water, and the temperatures required in your business.

York Ammonia Valves and Fittings.

We make a specialty of Ammonia Valves and Fittings.



A large section of our works is devoted exclusively to this business.

The foundry devoted to this work is equipped with special melting and annealing furnaces, with the result that our valves and fittings are nearly double the tensile strength of those made in the ordinary way.

For the convenience of the trade, we carry full lines of ammonia valves, fittings and other supplies, in all of the principal cities. Shall we send you our Illustrated Catalogue, which will enable you to order from our nearest supply houses?

THEIR PRICES ARE THE SAME AS OURS

York Manufacturing Co.

Largest Ice Machine Manufacturers in the World.

Main Office and Works:
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General Western Office: - - - Monadnock Block, Chicago.
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BRANCHES IN

Boston New York Philadelphia Pittsburgh Atlanta
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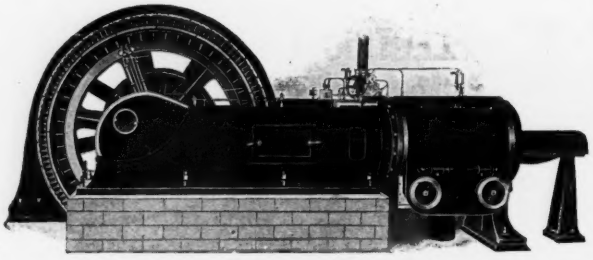
RUSSELL
4-Valve Automatic Cut-off
ENGINE



You will find Russell Engines of this type in Light and Power Plants everywhere. Its introduction to the steam-using public occurred long ago, at a time when the refinements of the electrical industry required a prime mover embracing speed, close regulation, economy and continuous, smooth and noiseless operation. Russell Four-Valve Engines met that requirement then—they meet it now. But today they have the advantage gained by hundreds of successful installations.

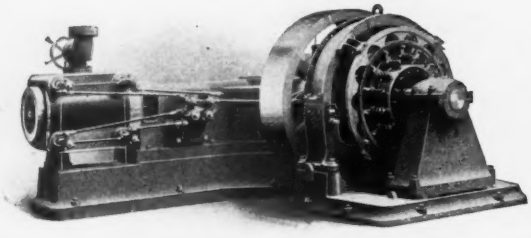
The illustration above shows you a Russell enclosed, self-oiling, four-valve, engine—plain, rigid and sturdy in appearance, yet embodying that dignity and grace of outline which invariably accompany correct proportion and proper distribution of metal.

The valve arrangement is peculiar to the Russell—it differs from any other engine built. The admission, cut-off, release and compression are each taken care of by separate devices. This makes possible the adjustment of any one of these four points independently of the others.

This valve gear arrangement and the other good characteristics of Russell Simple and Tandem Compound Four-Valve Engines are illustrated and described in our catalog.

IF YOU'LL WRITE WE'LL SEND YOU A COPY

THE RUSSELL ENGINE COMPANY
Massillon, Ohio, U. S. A.



Maximum Economy

in the consumption of steam and oil is guaranteed for and secured from

Ridgway Four-Valve Engines

and an unbiased investigation of our claims will convince you of this fact.

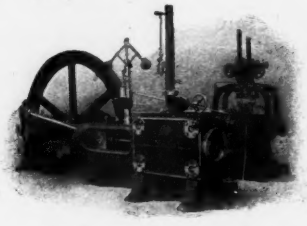
We invite the most rigid tests, and offer every prospective purchaser the use of our testing facilities.

Our collection P of descriptive Bulletins will be sent to interested parties.

RIDGWAY DYNAMO & ENGINE COMPANY
RIDGWAY, PA.

Established 1867

THE VILTER MFG. COMPANY,
972 Clinton Street, - MILWAUKEE, WIS.



Ice Machine operated by Corliss Engine

CORLISS ENGINES and ICE MACHINES

Chicago Office, Monadnock Building.

Have You Seen The Latest

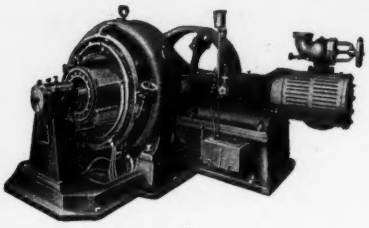
IN Steam Turbines, Centrifugal Pumps, Turbine-Driven Boiler Feeders, Centrifugal Blowers, Centrifugal Air Compressors, Turbine-Driven Direct-Current Generators, Centrifugal Fire Pumps, Centrifugal Hydraulic Pressure Pumps, and other Turbine and Centrifugal Machinery.

Catalog No. "C50" will show you the most efficient steam turbines for all sizes of centrifugal pumps for all heads and capacities from circulating and boiler feed pumps to waterworks pumps. The booklet also illustrates high-pressure blowers and air compressors directly connected to steam turbines. Sent upon request.

DE LAVAL
STEAM TURBINE CO., - TRENTON, N. J.

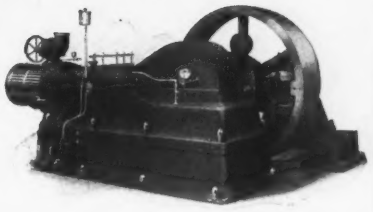
56

SKINNER ENGINES



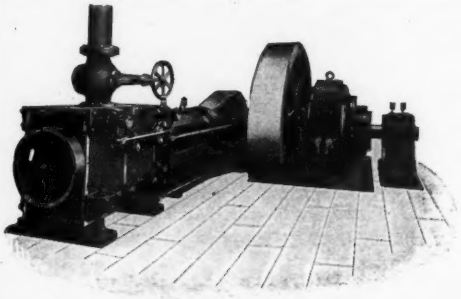
are equipped with a Governor, Valve and Oiling System universally conceded to have no equal.

ENDORSED BY OVER 9,000 ENTHUSIASTIC USERS.



SKINNER ENGINE CO., ERIE, PA.

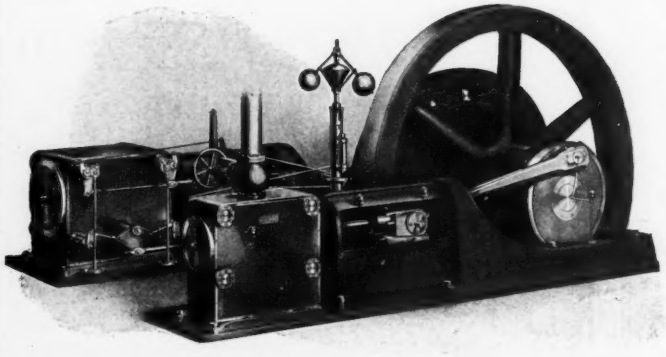
BRANCHES IN 21 CITIES



HAMILTON CORLISS ENGINES

are the most Economical Steam operated prime movers known. Let us show you some, or write for Bulletins.

The Hooven, Owens, Rentschler Co, Hamilton, Ohio



THE C. & G. COOPER CO.

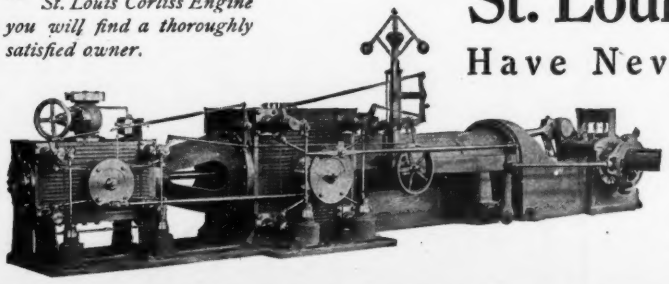
ENGINE BUILDERS

STEAM	GAS
50 to 10,000 Horse-Power	250 to 3000 Horse-Power

Write us for Full Information

Home Office and Works: - **MT. VERNON, OHIO**

WHEREVER you see a St. Louis Corliss Engine you will find a thoroughly satisfied owner.



St. Louis Corliss Engines

Have Never Failed To Satisfy

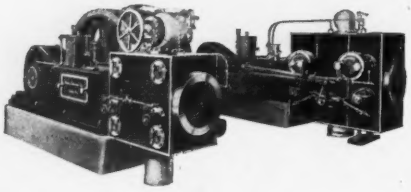
They are built for hard, exacting service, and quality is never sacrificed for cost.

May we favor you with a Catalog and list of users?

St. Louis Iron & Machine Works,

Chouteau Ave., Main and 2nd Street, - ST. LOUIS, MO.

New York Office: 50 Church Street.



The Success of Corliss Engines at Slow Speeeds is unquestioned.

The drop cut-off gear is responsible.

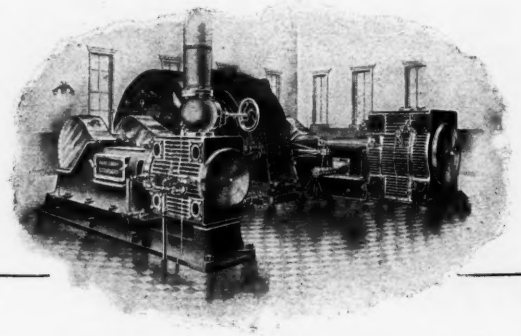
The Success of Ball Corliss Engines at High Speeds is unquestioned.

The non-detaching Valve Gear is responsible.

This gear is patented. It is found only in Ball Engines. By its positive action it gives the valves the *same Movement* that the *Drop-Cut-off* of the Slow Speed Corliss *produces* by picking up and dropping them. It also permits the use of *true Corliss Valves* — the valves that have survived the test of time — the valves that wear least, remain tight longest, and operate with the minimum amount of steam.

On account of their superior economy, close regulation, and noiseless operation, Ball Corliss engines are used in many important light and power plants. List of installations will be gladly furnished.

Ball Engine Company
Erie, Pa.



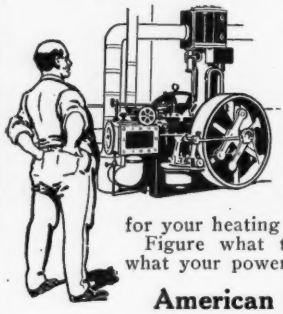
FLEMING - HARRISBURG ENGINES

SINGLE and CORLISS VALVE
SIMPLE and COMPOUND

Have Established a Record in Economical Operation. Undoubtedly the Best Adapted Engine for Electric Generating Service on the Market.

Harrisburg Foundry and Machine Works,
Harrisburg, Pa.

POWER What Will It Cost?



In figuring on central station and isolated plant power, don't overlook the fact that when you buy current, you will have also to install boilers, chimney, grates, heaters, pumps, piping, etc., for your heating system.

Figure what this will cost you and then what your power will cost with an

American Ball Angle Compound Engine

producing your power as a by-product of your heating system.

The American Ball Angle Compound Engine is recommended for this service because of its economy, angle construction and arrangement of cylinders, giving four impulses per revolution and therefore constant turning effort, also small floor space and freedom from vibration. These and other advantages make the American Ball Angle Compound Engine, the foremost engine for all steam plant work.

Ask us for particulars, blueprints and our Pamphlet, "The Modern Automatic High Speed Engine."

American Engine Company
48 Raritan Avenue
BOUND BROOK, NEW JERSEY

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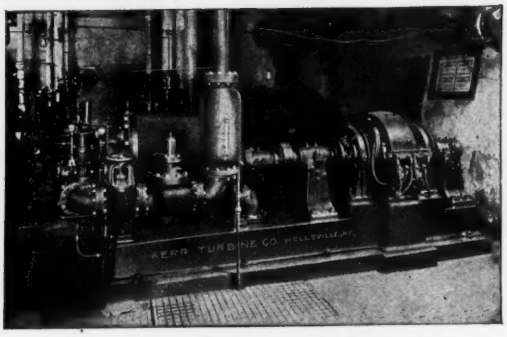


ONE KERR TURBINE VERSUS TWO RECIPROCATING ENGINES

The Y. M. C. A. and Men's Hotel Buildings, Buffalo, N. Y., both receive light and power from the plant shown. The installation, which is in the Y. M. C. A. building, consists of two direct-connected reciprocating steam engines, each 50 kw., and one 100 kw. Kerr Turbo-Generator Unit. Our arithmetic says, 2 × 50 kw.=100 kw., but the Kerr Turbine will carry the entire load at times when the other units combined will not. The two reciprocating engines should carry the load: *they don't.* The Kerr Turbine should carry the load: *it does.*

Wear always "gets" a reciprocating engine; there are too many rubbing surfaces to ensure durability. When new, reciprocating units will pull the load satisfactorily, but wear will cause the valves to leak; the cylinders need reboring; steam is wasted and the loss made even more excessive by improper setting of valves; the danger of developing a knock and of blowing out a cylinder head on account of entrained water is ever present; and too much attention is required.

Fogy notions and reciprocating engines are often so closely allied that where reciprocating engines wear out and get scrapped regularly, it is believed that nothing but new reciprocating engines will do.

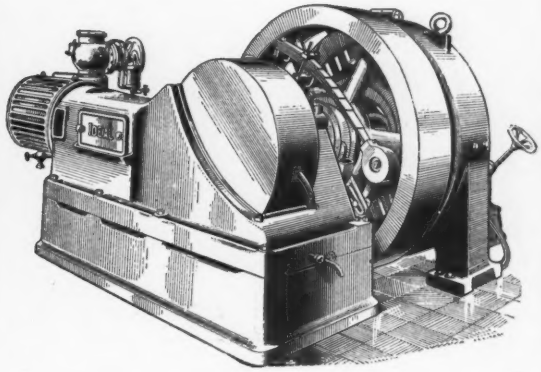
The owner who in despair finally looks into power matters carefully will do well to investigate the dependable Kerr Turbine. There's none of this junk-heap engineering about them. They outlast reciprocating engines because there are practically no wearing parts and almost no frictional contacts. The only rubbing surfaces, the two rotor bearings, are positively protected by ring oilers which need practically no attention other than dumping in oil at long intervals. The Kerr Turbine is efficient, uses no more steam after many years of service than it does when new. We are prepared to vouch for this from thorough service tests. This continued high steam economy during long life is essential to ultimate *dollars and cents* economy on any power apparatus. It's what you want and what you get with the Kerr Turbine.

Replace your worn out reciprocating engine with a Kerr Turbine and you will have a highly profitable investment. A Kerr turbine is further desirable because it occupies little space; there is no vibration; regulation is better than in reciprocating engines; the maintenance cost is practically nothing; and every part is easily accessible. We have many more arguments and give them fully in our bulletins. These bulletins show how and why Kerr Turbines are economically used for driving blowers, alternating or direct current generators, centrifugal pumps, etc. State your needs and our engineers will submit figures and proof of the Kerr Turbine's ability for handling your work.

KERR TURBINE CO.

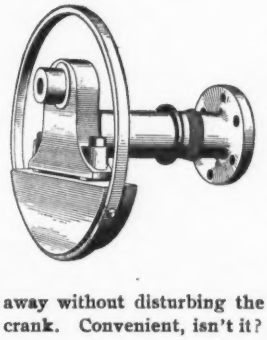
STEAM KERR TURBINE Wellsville, New York

Agents in All Large Cities 29



IDEAL ENGINES

Overcome the difficulties encountered in other engines when commutators need truing.



Ordinarily this means lifting out the entire crank and with it a solid wheel, or else a split pulley must first be removed. With the Ideal Engine it's different. Simply withdraw the bolts that pass through the flanges of shaft and extension. Then the armature and the shaft extension may be taken away without disturbing the governor, wheel, or main crank. Convenient, isn't it?

Another splendid advantage of this coupled shaft construction is manifest before the engine is installed. If the generator manufacturers are to mount the armature, only the shaft *extension* is sent to them. There is no risk to shaft alignment by shipping the complete crank.

For convenience in erecting the engine a temporary shaft extension is sent with it. After the bearings are lined up with this light, hollow shaft, the regular shaft and wheel can be put in place and can remain there.

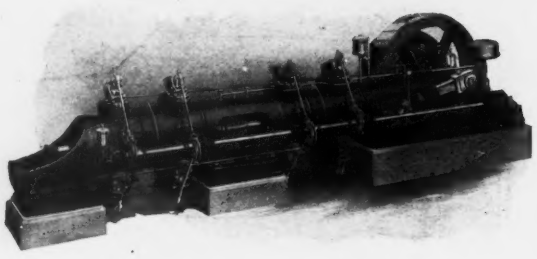
The entire crank-shaft construction is a tremendous success.

Write for copy of Bulletin Nineteen.

A. L. IDE & SONS
Springfield, Illinois, U. S. A.

Steam Gas

BUCKEYE GAS ENGINES FOR VARIABLE SPEED SERVICE



In driving pumps, blowers, exhausters, etc., a marked saving of fuel, lubricating oil and engine wear may be effected by running the engine at variable speed corresponding to the load.

For such service Buckeye Gas Engines are equipped with a simple variable speed governing device, by which the operator may at will vary the engine speed from normal to half speed or less.

At the same time the governor holds the engine closely to the speed for which the device is set, regardless of load changes.

This device may also be operated by a motor controlled from the switchboard and when so equipped is of inestimable value for synchronizing alternators.

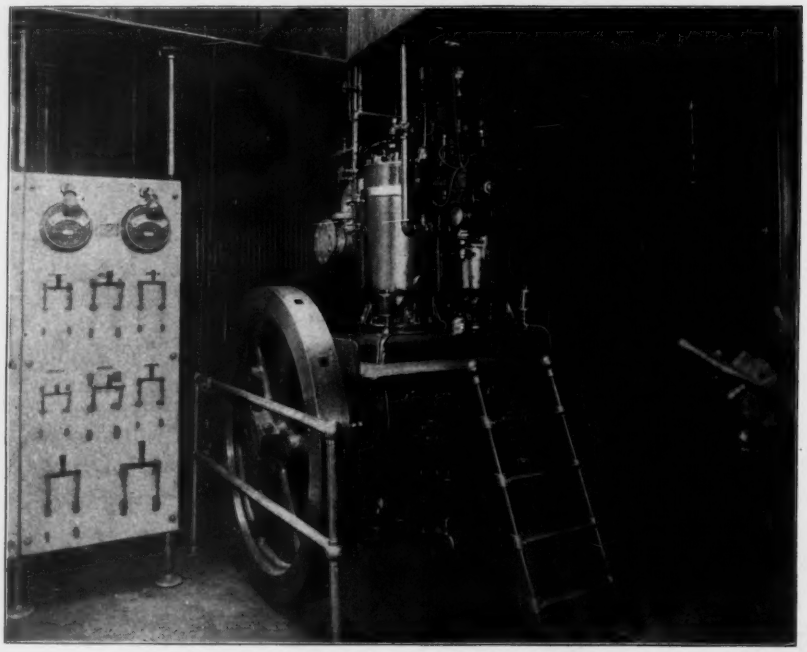
BRANCH OFFICES:

Birmingham—Brown Marx Bldg.
Baltimore—100-2 Fayette St.
Chicago—1249 Marquette Bldg.
Cleveland—1116 New England Bldg.
Cincinnati—111 Ingalls Bldg.
Pittsburg—1601 Arrott Bldg.
Philadelphia—1020 Stephen Girard Bldg.
Denver—1710 Glenarm St.
New York City—39-41 Cortlandt
St. Paul—4th and Wacouta Sts.

BUCKEYE ENGINE CO., SALEM, OHIO

Gas Steam

BRUCE-MACBETH GAS ENGINES



Illustrating Bruce-Macbeth Twin Cylinder Type Gas Engines, furnished usually on specifications calling for 35 to 80 H. P.

For

Electric Lighting and Power

"Bruce-Macbeth Engines give the most power at the least expense."

Compact, reliable and built in a wide variety of sizes.

Operate on Natural, Producer or Artificial Gas.

Watch this space for up-to-date power equipment.

Bruce-Macbeth Engine Co.

2108 Center St., N. W., Cleveland, O.